

National Aeronautics and Space Administration



NASA's FY 2014 Management and Performance

Including the FY 2012 Agency Performance Report

And the

FY 2013 Performance Plan Update
FY 2014 Performance Plan

www.nasa.gov

INTRODUCTION

The Management and Performance section of NASA's Congressional Justification describes the Agency's approach to performance management. The complete section is available on <http://www.nasa.gov/news/budget/index.html>, and provides a comprehensive record of past and planned performance for Agency programs and projects, from 2007 to 2014. The Management and Performance section:

- Describes NASA's performance management cycle and its underlying processes and tools;
- Presents the Agency's FY 2012 performance in the Annual Performance Report;
- Updates commitments set last year in the FY 2013 Performance Plan;
- Sets performance targets in the FY 2014 Performance Plan aligned with this Congressional Justification budget request;
- Presents program performance against cost and schedule estimates in the Major Program Annual Report; and
- Discusses the results of performance evaluations and subsequent improvement actions.

NASA's Approach to Performance Management

"NASA's Approach to Performance Management" shows that activities follow a cycle that allows for feedback among three phases: Plan, Evaluate, and Report. This cycle integrates processes and tools to:

- **Plan** and implement strategy and performance;
- Monitor and **evaluate** performance toward commitments;
- **Report** decision-making information to NASA leaders and other stakeholders; and
- Inform future planning.

The Agency's performance management cycle begins with the planning phase. NASA leaders employ two distinct planning processes for setting long- and short-term priorities. NASA's management councils first set the strategic plan, which lays out the Agency's long-term priorities and commitments, and its strategy and performance. The framework aligns the implementation activities of programs and projects with the Agency's strategic direction. Next, NASA builds its annual performance plan upon the strategy and performance framework. Annual performance plans contain the tactical, short-term steps necessary along the path to each strategic goal.

Evaluation is the second phase of the performance management cycle. The Agency continually monitors progress against targets as programs and projects execute the performance plan. NASA leverages an internal performance assessment process to collect objective evidence of Agency performance. NASA relies on a suite of data collection and analytics tools to support these performance management activities. Specifically, in 2012, NASA launched an Agency-level system, called Performance Warehouse, to manage data collected in compliance of the [Government Performance and Results Act \(GPRMA\)](#) [Modernization Act of 2010 \(GPRAMA\)](#). Since its implementation, the system has streamlined collection, improved quality, and increased accessibility of NASA performance data.

Reporting results to decision-makers and stakeholders is the third phase of NASA's performance management cycle. NASA leverages a quarterly reporting process with other on-going assessments to drive performance information to decision-makers. NASA's recent efforts are focused on maximizing the

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outcomes of the quarterly reporting process by using the Performance Warehouse, because it increases the Agency's capacity for using evidence and evaluation in decision-making. NASA leaders and stakeholders make key investment, policy, and performance decisions based on insights from objective performance evidence and robust evaluations. These decisions drive leaders to renew, adjust, or reset strategic and performance plans.

Performance Reporting and Planning

In "Performance Reporting and Planning," NASA presents the combined FY 2012 Annual Performance Report and FY 2013 and 2014 Performance Plans. When past performance and future plans are integrated in one report, they reveal performance trends across NASA's investment portfolio. Agency leaders use this comprehensive view of performance information to plan future performance targets and strategy.

The combined performance report and plans demonstrate:

- Adherence to Agency-wide performance management processes, as described in "NASA's Approach to Performance Management";
- Six years of historical performance information and two years of future commitments on the path to each strategic goal;
- Adjustments to FY 2012 and FY 2013 performance plans to align with budget and congressional and/or the President's and strategic direction;
- Achievements toward Priority Goals¹ and Cross Agency Priority Goals; and
- NASA's commitment to transparency and accountability.

Addressing Management Challenges and Improving Performance

Comprehensive evaluations enable meaningful performance reports and inform planning activities. "Addressing Management Challenges and Improving Performance" provides an assessment of NASA's performance, with a focus on performance shortfalls and the effectiveness of corrective actions. It presents the results of continuous performance evaluation, as well as results from performance improvement efforts. NASA's evaluations:

- Rely on performance evidence from NASA Performance Warehouse and other internal performance management tools;
- Reflect assessment from stakeholders and independent assessors;
- Identify persistent issues affecting performance; and
- Inform actions to improve performance.

¹ When originally published, these goals were designated as High Priority Performance Goals. The GPRM Modernization Act of 2010 and subsequent guidance from OMB changed the designation to Agency Priority Goals. NASA is using "Priority Goals" to refer to both the original High Priority Performance Goals set in 2011 and the Agency Priority Goals set later.

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In 2014, NASA will develop a new strategic plan and supporting performance plans that will continue to reflect Agency and National priorities, as specified by Congress and the Administration. The evaluations presented in this section will inform leadership as the Agency sets its course for the next ten years, and beyond. The Agency will publish its 2014 Strategic Plan and supporting performance plans, along with historical performance plans and reports, on NASA's budget Web page at <http://www.nasa.gov/news/budget/index.html>.

NASA'S APPROACH TO PERFORMANCE MANAGEMENT

“NASA’s Approach to Performance Management” summarizes planning strategy and performance through performance evaluation and reporting. First, it provides an overview of NASA as a performance-based organization, the basis for effective performance management. It then discusses each phase of NASA’s performance management cycle, and the processes and tools that support each phase. It provides context for understanding the performance reports and plans in “Performance Reporting and Planning.” This section also summarizes NASA’s approach to using evidence and evaluation of performance to inform investment decisions and future planning, which “Addressing Management Challenges and Improving Performance” discusses in further detail.

A Performance-Based Organization Enables Effective Management

Foundational to effective performance management is the organization and its people. A performance-based organization has a strong alignment of its strategic and performance plans with its planned investments; monitors and reports on the success of or challenges for those investments; and uses this information to set future directions. NASA is a performance-based organization that manages the work of each installation to accomplish its Vision and Mission.

VISION AND MISSION

NASA’s Vision is

To reach for new heights and reveal the unknown, so that what we do and learn will benefit all humankind.

To make this Vision a reality, each day NASA pursues its Mission to

Drive advances in science, technology, and exploration to enhance knowledge, education, innovation, economic vitality, and stewardship of Earth.

ORGANIZATIONAL STRUCTURE

Under the leadership of the [Administrator](#), NASA offices at [Headquarters](#) provide overall guidance and direction to the Agency. NASA’s [Centers](#) and installations conduct the Agency’s day-to-day work in laboratories, on airfields, in wind tunnels, in control rooms, and in NASA’s other one-of-a-kind facilities.

NASA is organized to accomplish its mission while providing a framework of sound business, management, and safety oversight. The Office of the Administrator provides top-level strategy and direction for the Agency. The Administrator and his officers help guide programmatic direction for NASA’s missions and guide the operations of the Centers.

Four organizations lead the pursuit of NASA’s mission and set technical performance commitments aligned with their budgets:

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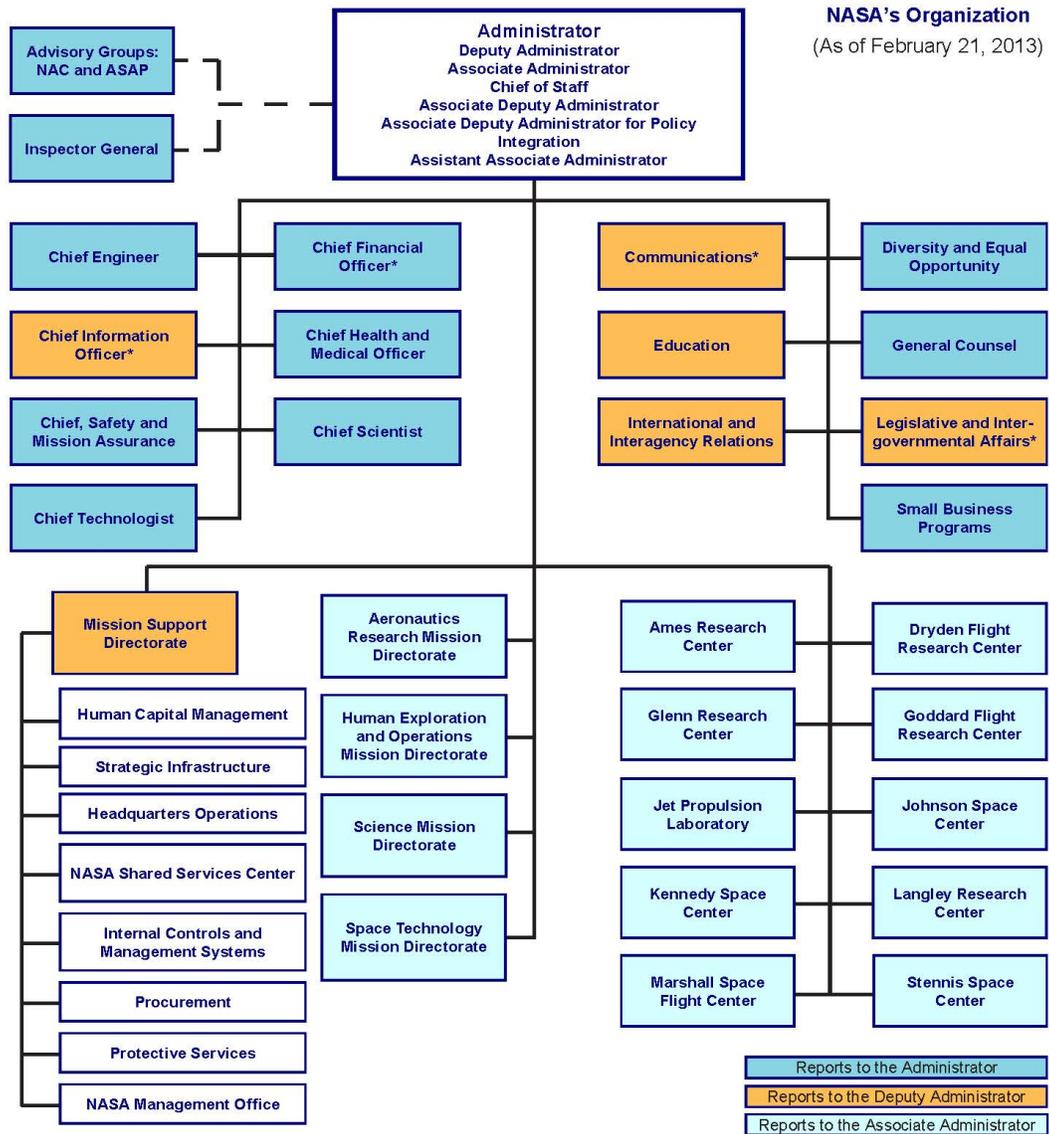
- Science Mission Directorate (SMD) manages the Science budget account and focuses on programmatic work in the disciplines of Earth, planetary, astrophysics, and heliophysics research;
- Aeronautics Research Mission Directorate (ARMD) manages the Aeronautics account and applied research activities that improves the current and future state of air travel;
- Space Technology Mission Directorate (STMD), new in FY 2013, manages the Space Technology account to support the crosscutting activities of the Office of the Chief Technologist. STMD coordinates and supports advanced technology development within the Agency and the commercial sector; and
- Human Exploration and Operations Mission Directorate (HEOMD) manages the Exploration and Space Operations accounts. HEOMD manages development of the Orion Multi-Purpose Crew Vehicle (Orion-MPCV), future exploration technologies, and works with U.S. commercial space industry partners to develop commercial systems for providing crew and cargo transportation services to and from low Earth orbit. HEOMD also manages operations and research for the International Space Station (ISS), and communications systems and networks that enable deep space and near-Earth exploration.

A fifth organization aligns its performance plans and budget to support all the mission goals in a crosscutting manner. The Mission Support Directorate (MSD) manages the Cross Agency Support (CAS) and Construction and Environmental Compliance and Restoration (CECR) accounts. These accounts fund operations at Headquarters and the Centers as well as institutional and programmatic construction of facilities. MSD, through the CAS account, includes support offices that set policy and strategy for specific crosscutting Agency functions including safety and mission assurance, technology planning, education, equal opportunity, information technology, financial administration, small business administration, international relations, and legislative and intergovernmental affairs. Among other responsibilities, these offices report to the Administrator and other stakeholders on progress towards national initiatives, provide independent reviews and/or investigations, and liaise with the public and other federal agencies. While based at Headquarters, these offices typically have representatives at the Centers and provide a coordinating and control function.

Figure 1.1 shows the NASA organizational structure, current as of February 2013.

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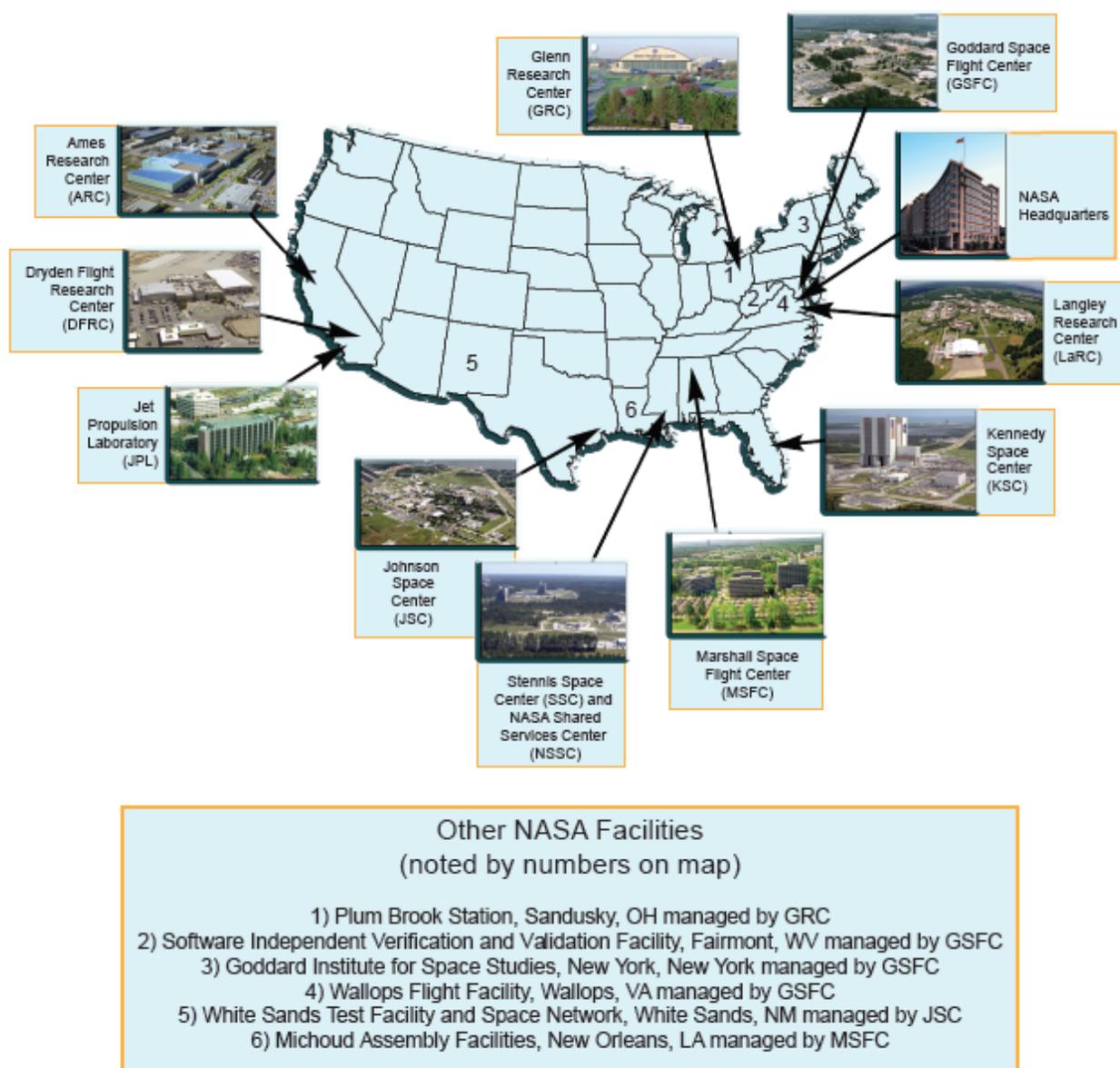
Figure 1.1: NASA's Organization



NASA employs about 18,000 civil servants who work at Headquarters in Washington, DC, the Centers, and other facilities. NASA staffs each location with a contractor workforce for technical and business operations support. Figure 1.2 shows the range of NASA's facilities.

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Figure 1.2: NASA Centers and Facilities Nationwide



The Jet Propulsion Laboratory (JPL) is a Federally Funded Research and Development Center in Pasadena, California. The California Institute of Technology manages JPL.

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Performance Management Cycle

NASA's performance management activities follow a cycle that ensures strategic management and accountability. Figure 1.3 shows NASA's performance management cycle.

Figure 1.3: Performance Management Cycle



In the planning phase, NASA's governing councils set the strategy, the performance framework, and the strategic plan, which consists of the Agency's long-term priorities and commitments. Then, NASA management builds its performance plan to align with the framework, ensuring that short-term priorities support the Agency's overall strategic direction.

In the evaluation phase, NASA managers monitor and measure performance of programs and projects against the fiscal year's performance plan. NASA leverages an internal performance assessment process to collect objective evidence of progress. Performance analysts verify and evaluate that evidence. When the interim data suggests a risk of performance shortfalls, the Agency requests additional information to understand and mitigate the risk.

The reporting phase connects evaluation to planning efforts. NASA managers present performance information to senior leaders, such as council members, and other stakeholders. The performance results reflect objective evidence and thorough evaluation obtained in the evaluation phase, and inform investment, policy, and performance decisions made in the planning phase of the next performance management cycle.

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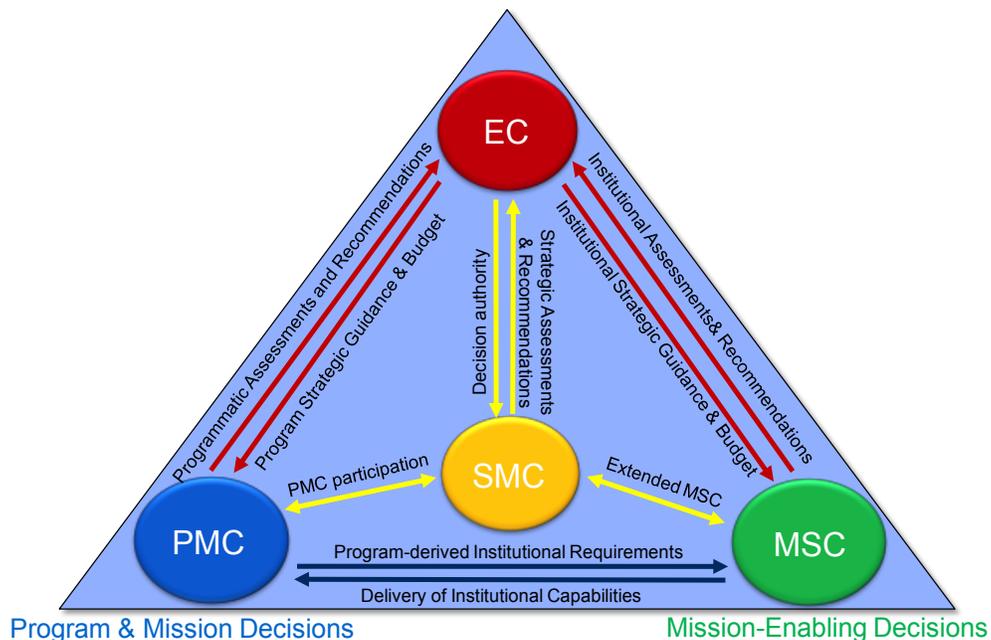
Strategic Management and Governance

Governance by council provides high-level oversight of the Agency-wide planning efforts that take place in planning phase of NASA's performance management cycle. NASA council members use the results of performance evaluations to shape the Agency's strategy and set its long-term priorities. NASA's governance policy ensures that leadership takes a rigorous and data-driven approach to their strategic management decisions. This disciplined governance enables efficient decision-making and planning. As shown in Figure 1.4, the governance councils affect all phases of the performance management cycle. The councils set the strategic plan and the strategy and performance framework in the planning phase. The councils drive assessment requirements of Agency performance in the evaluation phase. Finally, the councils review the results of those evaluations during the reporting phase to support decisions on new plans, and on-going implementation and operations.

NASA governs with three Agency-level councils, each with a distinct set of responsibilities. NASA Policy Directive 1000.3 includes the charters, responsibilities, and decision-making authorities of each council:

- The Executive Council (EC), supported by the Strategic Management Council (SMC),
- The Program Management Council (PMC), and
- The Mission Support Council (MSC).

Figure 1.4: Functional Relationships Between NASA's Governing Councils



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Each council plays a key role in supporting NASA's performance management cycle. EC determines NASA's strategic direction, assesses Agency progress toward achieving the NASA Vision, and serves as the senior decision-making body for Agency-wide decisions. PMC is the senior decision-making body regarding NASA's program portfolio, and so guides execution of the strategy and performance framework. MSC ensures the Agency has the capacity to reach its goals. It is the senior decision-making body regarding all mission support policy and activities, including facilities, workforce, information technology, infrastructure, technical capabilities and associated investments and divestments, regardless of funding source.

In support of EC, SMC serves several functions. When delegated by EC, SMC provides:

- Advice and counsel to senior leadership on key issues of the Agency;
- Input on the formulation of Agency strategy; and
- Makes decisions regarding strategic direction and planning.

To augment this formal governance structure, NASA's Baseline Performance Review (BPR) serves as NASA's monthly senior performance management review, integrating Agency-wide communication of performance metrics, analysis, and independent assessment for both mission and mission support programs and activities. While BPR is not a decision-making body, members of the councils attend BPR, and performance information presented during BPR informs council activities. The review complements the Executive, Program Management, and Mission Support Councils by providing continuous performance monitoring between key council decisions.

THE STRATEGY AND PERFORMANCE FRAMEWORK

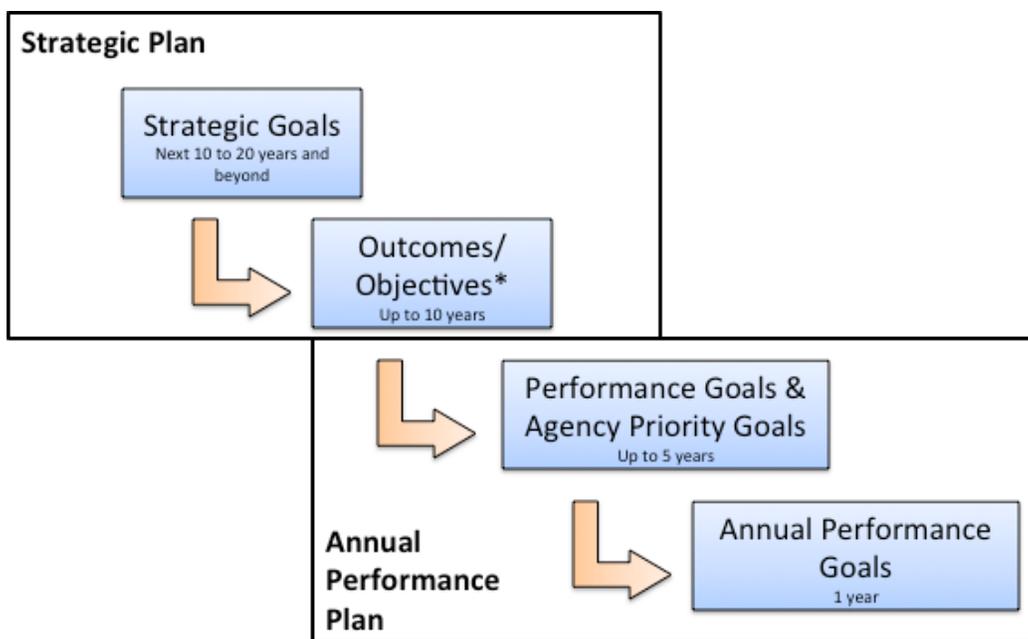
The strategic plan, as set by EC, establishes a strategy and performance framework that aligns short-term performance targets with the Agency's long-term commitments. The current strategy and performance framework consists of the elements of the strategic plan and annual performance plans as seen in Figure 1.5. The strategy and performance framework has five, distinct elements:

- Strategic goals,
- Outcomes,
- Objectives,
- Performance goals, including Priority Goals, and
- Annual performance goals.

The internal implementation plans of individual offices and NASA Centers flow from the framework. Internal implementation plans guide each entity's activities toward achieving performance goals and annual performance goals. Due to their technical nature, these plans generally remain internal to the Agency.

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Figure 1.5: NASA’s Strategy and Performance Framework



STRATEGIC PLAN

NASA’s current [strategic plan](#), published in 2011, reflects the top three levels in the strategy and performance framework. The strategic goals, outcomes, and objectives result from rigorous internal planning and external consultation with the Agency’s stakeholders.

The Agency’s senior leaders set the strategic plan to reflect the Agency’s strategic direction and priorities, as agreed to with Congress and the Administration. Updates occur according to the timelines set by the Government Performance and Results Act (GPRA) Modernization Act (GPRAMA) of 2010. As such, the Agency plans to update its strategic plan in 2014 with input from stakeholders, including Congress and the Office of Management and Budget.

In accordance with GPRAMA, NASA also delivers its Agency Priority Goals with its strategic plan, to signify the importance of these ambitious, short-term goals in the overall achievement of NASA’s strategy. Agency Priority Goals are discussed in more detail in “Performance Reporting and Planning.”

ANNUAL PERFORMANCE PLANS

While the strategic plan primarily focuses on long-term activities, NASA’s annual performance plans set short-term targets for programs, projects, and organizations through performance goals, Priority Goals, and annual performance goals. Performance goals and Priority Goals focus on planned progress over the next 18 months to five years. Annual performance goals align to NASA’s budget themes and programs in the Congressional Justification. NASA publishes these measures in annual performance plans, which also identify each responsible program or office. The FY 2013 and 2014 Performance Plans are included in “Performance Reporting and Planning.” In its performance plans, NASA also sets targets for mission

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support activities that support program and project activities. These performance commitments span the mission support portfolio in a range of areas, including human capital, information technology, infrastructure, and operational processes.

Performance Management

Rigorous planning is followed by evaluation and reporting. Once NASA entities begin executing against commitments in the performance plan, Agency managers and performance analysts begin to monitor and evaluate performance. Internal reporting requirements drive the evaluation phase and call for analysis of results against planned performance. NASA continuously measures the Agency's progress in pursuit of its strategic goals, outcomes, and performance measures, and reports progress towards its targets to Congress and the public in the Annual Performance Report (APR). This year, the Agency shares its report combined with future annual performance plans, to provide a holistic view of NASA's performance.

The Agency monitors and evaluates performance toward plans and commitments using assessments. Through these assessments, managers identify issues, gauge programmatic and organizational health, and provide appropriate data and evidence to NASA decision-makers. NASA gathers and provides the data to management through the following type of assessments:

- On-going monthly and quarterly analysis and reviews of Agency activities;
- Annual assessments in support of budget formulation (for budget guidance and issue identification, analysis, and disposition);
- Annual reporting of performance, management issues, and financial position;
- Periodic, in-depth program or special purpose assessments; and
- Recurring or special assessment reports to internal and external organizations.

QUARTERLY REPORTING

Each quarter, program officials submit to NASA management a self-evaluation that includes a rating for each performance measure and the supporting information that justifies the rating. The results of quarterly performance assessments provide feedback to NASA leaders, allowing them to make course corrections through the year to maintain alignment with strategic goals. The quarterly performance reporting and supporting verification processes culminate in the annual performance report, and contribute to development of the Congressional Justification and performance plans.

ANNUAL ASSESSMENT RATING SCALES AND CRITERIA

NASA evaluates its progress toward achieving performance goals and annual performance goals against the Agency's standard rating scale, seen in Figures 1.6 and 1.7. NASA determines performance ratings based on a series of internal assessments that are part of ongoing monitoring of NASA's program and project performance. External entities, such as scientific review committees, aeronautics technical evaluation bodies, and OMB, validate the ratings prior to publication by NASA.

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Figure 1.6: Performance Goal Rating Scale

Rating	Rating Criteria for Performance Goals
Green (On Track)	NASA achieved or expects to achieve the intent of the performance goal within the estimated timeframe. NASA achieved the majority of key activities supporting this performance goal.
Yellow (At Risk)	NASA expects to achieve the intent of the performance goal within the timeframe; however, there is at least one likely programmatic, cost, or schedule risk to achieving the performance goal.
Red (Not on Track)	NASA does not expect to achieve this performance goal within the estimated timeframe.
White (Canceled or Postponed)	NASA senior management canceled this performance goal and the Agency is no longer pursuing activities relevant to this performance goal or the program did not have activities relevant to the performance goal during the fiscal year.

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Figure 1.7: Annual Performance Goal Rating Scale

Timeframe: When NASA will achieve the APG	Rating Criteria for Annual Performance Goal (APG) Types			Rating
	Single Milestone or Deliverable	Multiple Deliverables, Targeted Performance, and Efficiencies	On-going Activities, Services, or Management Processes	
Current FY as planned.	NASA achieved the event or the deliverable met the intent of the APG within the timeframe.	The program/project reached the stated numeric target.	The intended result of the program/project was achieved as defined by internally held success criteria.	Green
Achieve next FY (will not achieve this FY as planned).	NASA did not achieve this APG in the current fiscal year, but anticipates achieving it during the next fiscal year.			Yellow
Will not be achieved, but progress was made.	N/A	NASA failed to achieve this APG, but made significant progress as defined by reaching 80 percent of the target or other internally held success criteria.	The intended results of the program/project were not achieved in this fiscal year, but significant progress was accomplished, as defined by internally held success criteria.	
Will not be achieved.	NASA did not achieve the APG and does not anticipate completing it within the next fiscal year.	NASA achieved less than 80 percent of the target or other internally held success criteria.	Neither intended results nor significant progress were achieved. The progress toward the APG does not meet standards for significant progress for the internally held success criteria.	Red
Will not be achieved due to cancellation or postponement.	NASA senior management canceled this APG and the Agency is no longer pursuing activities relevant to this APG or the program did not have activities relevant to the APG during the fiscal year.			White

MANAGING PERFORMANCE DATA

Data management keeps the performance management cycle in motion by fueling evaluations and driving evidence-based reports to leaders. In July 2012, NASA implemented the Performance Warehouse, a database designed in partnership with the Department of Treasury. The system leverages technology and best practices to collect, maintain, and analyze performance information. The Performance Warehouse standardizes data collection and archiving, streamlines performance reporting, and enables more data analytics. NASA uses this system to track performance metrics for the entire performance cycle, beginning with measure development through evaluation and reporting.

Beyond supporting NASA’s internal management processes, these enhanced capabilities also provide a more efficient means to comply with legislative and executive branch requirements, such as preparing

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machine-readable formats of performance information, and carrying out verification and validation of performance data.

In September 2012, OCFO launched the companion system, the Performance Dashboard, which further streamlines evaluation and reporting activities. The new tool automates ad-hoc performance analysis, which increases NASA's capacity for focused, in-depth performance evaluations. The tool also automates reports and plans, such as the annual performance report.

Using Evidence and Evaluation in Decision Making

Laws, executive orders, and management "best practices" all dictate that organizations must set expectations for success and be accountable for achieving that success. Furthermore, agencies must demonstrate to stakeholders that their programs and activities do deliver the products or services expected, are managed and operated effectively (and efficiently), and continue to be relevant in a changing and dynamic environment. Collection and analysis of performance data and conduct of rigorous independent evaluation are essential in determining the success and validity of an investment.

- NASA monitors and assesses the engineering process of designing, building, and operating spacecraft and other major assets. Measures of performance for such investments tend to focus on comparisons of actual versus planned schedule and cost. The Agency continually monitors performance through the BPR, and additionally holds formal independent assessments as the project progresses through a series of gatekeeping "key decision points," or KDPs. Key decision points provide managers a time to review all aspects of performance and thoughtfully promote (or delay, or even terminate) work on a project. These points can occur at any time of the year, depending on the formulation, development, or construction plan.
- NASA's research programs often have broad goals, such as "understand the origin of the universe." To measure performance of these types of investments, NASA establishes and measures performance against smaller achievable goals that demonstrate a contribution to the knowledge on the subject. NASA conducts an assessment on these programs each year.
- NASA assesses technology research and development (R&D) programs against incremental milestones (technology readiness levels, or TRLs) in terms of research maturity and adoption. NASA regularly measures the TRL advancement of an individual technology investment, with overall technology portfolio assessments occurring each year.
- NASA's "operations" or support and service type programs generally assess progress on meeting their specific objectives, and can measure performance against targets for "output" or capacity of the activity, quantifiable estimates of improvement with aggressive targets (e.g., reducing operating costs by two percent in two years), or even customer satisfaction. These assessments tend to be annual in nature.

Evaluations drive decisions on a range of NASA investments, small and large. A series of decadal surveys and other analyses, conducted by the National Research Council of the National Academies, helps inform decisions about the Science investment portfolio and other aspects of NASA's R&D efforts. This external "evaluation" of user needs and requirements, in combination with performance assessment of on-going activities, helps ensure that NASA's research priorities and investments stay current with the needs of the research community. The Space Technology Roadmap is a similar planning tool, reflecting the R&D and technology needs of NASA, the government, and industry. NASA uses external peer review panels to

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objectively assess and evaluate proposals for new work in the disciplines of research, technology development, and education. NASA often contracts internal and external evaluators to assess impact, efficiency and effectiveness, cost to benefit, and the relevance of work being performed. Evaluations are a routine business activity in the NASA fields of education, facilities maintenance and operations, procurement and contract operations, and logistics.

In addition to the program or theme-based evaluations, NASA also conducts evaluations across its portfolio. As a part of NASA's performance management cycle, NASA reports the results of those evaluation activities at regular interval to Agency leaders. The following sections highlight the evaluative methods employed by NASA to assess performance and performance improvement. Through this evidence-based strategic management, NASA has improved management oversight of project cost, schedule, technical, and institutional performance with the implementation of Cross Agency initiatives, policy adjustments, and other techniques. The "Performance Reporting and Planning" subsection documents how evaluation and reporting culminate in the Agency's annual performance report and plans. "Addressing Management Challenges and Improving Performance" provides an in depth discussion of NASA's evaluative approach. The subsection discusses these three aspects:

- NASA's evaluation methodology,
- The results of evaluations, and
- The effectiveness of previous improvement efforts.

The evaluation phase of the performance management cycle highlights the Agency's improvement opportunities. For example, the evaluation results could reveal a need for cross-Agency coordination efforts, increased oversight, or policy adjustment. Leveraging insights from the FY 2011 performance management cycle, NASA implemented tools and processes in FY 2012 that streamlined planning, evaluation, and reporting. In so doing, the Agency increased its capacity to focus on performance improvement in FY 2013.

Each quarter, NASA presents to senior leaders at BPR an evaluation and summary of performance goals based on evidence provided by programs. Additionally, an independent assessment team provides evaluations of technical, cost, schedule, and programmatic details for major spaceflight and technology projects and programs. OCFO also presents a summary of progress made toward achieving all performance measures, as well as a discussion of relevant performance issues.

Center and mission directorate-level offices and key Headquarters Offices support BPR. As an integrated review of institutional and program activities, BPR highlights interrelated issues that impact performance and program risk enabling senior management to quickly address issues, including referral to the governing councils for decision, if needed. The BPR forum fosters communication across organizational boundaries to address mutual concerns and interests. The objectives of the forum are to:

- Provide NASA senior leadership comprehensive, integrated, and objective information that describes the performance of the Agency's programs, projects, and institutional capabilities (i.e., the full portfolio at one time);
- Ensure open cross-functional communications among NASA's organizations to enhance Agency performance; and
- Identify and analyze performance trends and crosscutting or systemic issues and risks.

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No matter the type of activity, NASA monitors performance with an eye to benefit received or to be received in the future. Results of performance assessments and evaluations inform decisions on program restructuring, initiation or termination, and changes in policy or management strategies. Across the board, NASA's FY 2014 budget request reflects prioritizations and decisions based on performance evidence and evaluations.

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NASA leverages the reporting phase of its performance management cycle to bring actionable information to Agency decision-makers and to inform future plans. This section demonstrates that the integration of performance reporting and performance planning information provides insights to NASA leaders to enhance overall performance management. The combined performance report and plans include NASA's FY 2012 Performance Report, updates to the FY 2013 Performance Plan that was provided with the FY 2013 Congressional Justification in February 2012, and the new FY 2014 Performance Plan aligned with the current budget request.

Past to Future: Improved Performance Planning and Reporting

For over a decade, NASA kept performance planning and reporting as separate activities and published them as separate documents. Performance planning was part of budget formulation and execution, resulting with the concurrent publication of annual performance plan and Congressional Justification in February. NASA conducted performance reporting independently at the end of the fiscal year and published the results with the end-of-fiscal year financial statements in November.

Starting in FY 2013, Office of Management and Budget (OMB) Circular A-11 requires agencies to combine their Annual Performance Reports (APRs) and Annual Performance Plans (APPs). NASA elected to combine the APR and APP in FY 2012 to take advantage of the benefits of an integrated, yearlong process while also having more time to adjust to the new requirements. This combined reporting format better aligns with NASA's performance management cycle. NASA holds performance improvement discussions in tandem with performance planning so that measures for upcoming fiscal years are informed by past and current performance. This is helping NASA create better performance measures and conduct relevant assessments of programs and projects by improving baselines, targets or outcomes, and trending. As NASA looks beyond FY 2014, the Agency will leverage performance improvement to aid the development of a new strategic plan, which will be released with the FY 2015 Congressional Justification.

Measuring Against Priorities

In accordance with GPRAMA and a White House initiative for building a high-performing government, NASA works with other Federal agencies to address national needs through its contributions to several Cross-Agency Priority (CAP) Goals. In addition, NASA's own Priority Goals represent challenging, near-term targets that the Agency pursues to benefit the American people in the areas of human exploration, planetary science, and space technology.

CROSS-AGENCY PRIORITY GOALS

Per the GPRAMA Modernization Act requirement, Federal agencies address CAP Goals in their strategic plans, annual performance plans, and the annual performance reports. NASA currently contributes to the following CAP Goals:

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- Science, Technology, Engineering, and Math (STEM) Education: In support of the President's goal that the U.S. have the highest proportion of college graduates in the world by 2020, the Federal Government will work with education partners to improve the quality of science, technology, engineering and math (STEM) education at all levels to help increase the number of well-prepared graduates with STEM degrees by one-third over the next 10 years, resulting in an additional 1 million graduates with degrees in STEM subjects.
- Data Center Consolidation: Improve IT service delivery, reduce waste and save \$3 billion in taxpayer dollars by closing at least 1200 data centers by fiscal year 2015.
- Cybersecurity: Achieve 95% use of critical cybersecurity capabilities on federal executive branch information systems by 2014, including strong authentication, Trusted Internet Connections (TIC), and Continuous Monitoring.
- Sustainability: By 2020, the Federal Government will reduce its direct greenhouse gas emissions by 28 percent and will reduce its indirect greenhouse gas emissions by 13 percent by 2020 (from 2008 baseline).
- Entrepreneurship and Small Business: Increase federal services to entrepreneurs and small businesses with an emphasis on 1) startups and growing firms and 2) underserved markets.
- Strategic Sourcing: Reduce the costs of acquiring common products and services by agencies' strategic sourcing of at least two new commodities or services in both 2013 and 2014, that yield at least a 10 percent savings.
- Closing Skills Gaps: Close critical skills gaps in the Federal workforce to improve mission performance. By September 30, 2013, close the skills gaps by 50 percent for 3 to 5 critical Federal Government occupations or competencies, and close additional agency-specific high risk occupation and competency gaps.
- Energy Efficiency: Reduce Energy Intensity (energy demand/\$ real GDP) 50 percent by 2035 (2010 as base year).

Please refer to <http://www.Performance.gov> for NASA's and the lead agency's contributions and progress to these goals, where applicable.

NASA'S PRIORITY GOALS

In FY 2010, NASA developed and began reporting on a quarterly basis on five Priority Goals.² In FY 2012, NASA completed three Priority Goals begun in FY 2010, outlined in the table below. The other two goals were completed in FY 2011. NASA rated this first set of goals under the criteria used by the Agency for all of its performance goals, and the final ratings and rationale are provided below. NASA selected four new Priority Goals in February 2012. These are reviewed through a separate process, which is used government-wide. More information on this latter set of goals can be found below and at <http://goals.performance.gov/agency/nasa>.

² When originally published, these goals were designated as High Priority Performance Goals. The GPRM Modernization Act of 2010 and subsequent guidance from OMB changed the designation to Agency Priority Goals.

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AGENCY PRIORITY GOALS RETIRED IN FY 2012

Retired Agency Priority Goal	Responsible Organization	Rating
PG 2.1.5.2 (Priority): Study Earth from space to understand climate change, weather, and human impact on our planet by launching at least two missions by 2015.	Science Mission Directorate, Earth Science	Red
PG 1.1.1.2 (Priority): Safely fly out the Space Shuttle manifest and retire the fleet.	Human Exploration Operations Mission Directorate, Space Shuttle Program	Green
PG 4.1.2.1 (Priority): Increase efficiency and throughput of aircraft operations during arrival phase of flight.	Aeronautics Research Mission Directorate, Airspace Systems	Green

In FY 2012, NASA closed out three FY 2010 Priority Goals. NASA completed all milestones, with the exception of a loss of one of the two Earth Science missions that had been planned, due to a launch vehicle failure in FY 2011. In 2012, NASA successfully launched the second mission, the [NPOESS Preparatory Project \(NPP\)](#), which has been renamed the Suomi National Polar Orbiting Partnership (Suomi NPP), and completed the on-orbit checkout to close out the activities planned for that goal. Suomi NPP will extend key climate measurements begun by NASA’s Earth Observing System for the climate research and applications communities. As originally planned, Suomi NPP also will provide a pre-operational demonstration mission for validation and risk reduction for the National Polar Orbiting Environmental Satellite System (NPOESS), which was being developed by NOAA, the Department of Defense (DoD) and NASA. NPOESS has been reformulated and is now the Joint Polar Satellite System (JPSS), being developed by the National Oceanic and Atmospheric Administration (NOAA) and NASA. In addition, because of the delays in NPOESS that led to the creation of JPSS, there is a possibility of a gap in some of the Nation’s operational weather prediction capabilities. As a result, until the first JPSS satellite is launched and brought on line in 2016-2017, Suomi NPP sensor data and data products will serve as an essential gap-filler in the Nation’s satellite observational systems for civil and military operational weather prediction.

NASA worked throughout FY 2012 with each of the museums and centers designated to receive one of the retired [Space Shuttle](#) fleet and completed plans to transfer the orbiters. On April 18, 2012, NASA delivered Space Shuttle Discovery to the National Air and Space Museum’s Udvar-Hazy Center in Chantilly, Virginia. Space Shuttle Enterprise, which had been on display at Udvar-Hazy, was moved to the John F. Kennedy International Airport on April 27. NASA placed the orbiter on a barge and sailed it to a temporary display location on the deck of the Intrepid at Pier 87 in New York City on July 19. NASA delivered Space Shuttle Endeavour to Los Angeles International Airport on September 21, and placed it in its final resting place at the California Science Center. The Space Shuttle Atlantis was moved to its final display location at the Kennedy Space Center Visitor Center in November 2012.

Current air traffic control operations require an air traffic controller to generate and provide clearances manually (that include path and speeds) so aircraft can arrive at an established point on a route, and time-regulate entry into an airport’s terminal area, at a scheduled time during the arrival phase of flight. The manual process often results in inefficient paths for an aircraft’s flight and descent (particularly during higher traffic density operations) restricting the number of aircraft that can be processed for arrival operations, while increasing noise and fuel consumption. Success was seen in FY 2011 when NASA’s

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[Airspace Systems Program](#) field-tested the Efficient Descent Advisor (EDA) tool that proposes to the air traffic controller the speed and path changes that will allow an efficient arrival profile. Building on this success in FY 2012, NASA officially transferred the results of its research to the Federal Aviation Administration for further evaluation and potential operational use as part of a more widespread government effort to modernize the Nation’s air traffic control system.

NASA’s FY 2012-FY 2013 PRIORITY GOALS

Agency Priority Goal	Responsible Organization
Sustain operations and full utilization of the International Space Station (ISS).	Human Exploration Operations Directorate, International Space Station Program
Develop the Nation’s next generation Human Space Flight (HSF) system to allow for travel beyond low Earth orbit (LEO).	Human Exploration Operations Directorate, Exploration Systems Division
Use the Mars Science Laboratory Curiosity Rover to explore and quantitatively assess a local region on the surface of Mars as a potential habitat for life, past or present.	Science Mission Directorate, Mars Exploration Program
Enable bold new missions and make new technologies available to government Agencies and U.S. industry.	Office of the Chief Technologist

In FY 2012, NASA made significant progress toward achieving all of the Agency Priority Goals. A brief summary of progress is provided below, and more details found at <http://goals.performance.gov/agency/nasa>.

The [International Space Station \(ISS\)](#) is a major steppingstone in achieving NASA’s exploration goals across the solar system. The ISS provides a space-based research and technology development laboratory to safely perform multidisciplinary, cutting-edge research. In FY 2012, the laboratory had on-going operations and research activities. The demonstration of the delivery of supplies from a U.S. commercial provider for the first time since the laboratory was in service marked a groundbreaking success.

In line with the [NASA Authorization Act of 2010 \(P.L. 111-267\)](#), NASA is moving ahead with a deep space exploration program designed to carry human beings beyond low Earth orbit. This goal focuses on ensuring these programs finalize cross-program requirements and meet their milestone reviews in order to realize the long-term goal. In FY 2012, NASA successfully completed an integrated Systems Requirements Review for the combined Exploration Systems Development portfolio of the Orion Multi-Purpose Crew Vehicle (MPCV), the Space Launch System (SLS), and ground systems capabilities.

The [Mars Science Laboratory \(MSL\)](#) successfully reached Mars on August 5, 2012, after an eight-month trip from Earth. MSL has the overall science objective of exploring and quantitatively assessing a local region on the surface of Mars as a potential habitat for life, past or present, and is expected to remain active for one Mars year, or 687 days.

Through continued investment in technology, NASA is able to achieve increasingly challenging and complex science, exploration, and aeronautics mission goals, many of which will have direct public benefit through [technology transfer](#). This past fiscal year, NASA exceeded its goal of 1,990 technology-related products with 2,948 new products. These products include New Technology Reports, software

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usage agreements, new patent applications filed, patent licenses executed, and NASA Technology Mission Use Documents. These products represent the important first steps in the process of infusing them back into NASA's work and transferring them to U.S. industry.

Changes to NASA's Performance Plans

Each fiscal year, NASA's budget request to Congress contains an annual performance plan that aligns with the funds requested. Changes to a performance plan are generally reflected in the next year's budget request, if the change is known before the request is sent to Congress. If a change occurs after, then it is reflected in the annual performance report. NASA updates measures in the plan when the final appropriation differs from the amount requested, or if Congressional or Executive direction places a different emphasis on programs relative to what was initially requested. Additionally, the dynamic nature of research and development can lead to shifting priorities. This may result in NASA no longer pursuing activities originally identified in the annual performance plan or placing greater emphasis on another activity.

NASA's policy has been to allow one of the following actions if programs are impacted by Congressional budget action via an appropriations or authorization law or Executive direction places a different emphasis on programs:

- Eliminate the performance measure (do not rate the performance measure);
- Change the targeted performance (rate at the new target); or
- Move the measure to the next year's annual performance plan (do not rate until the following year).

If priorities have shifted due to the dynamic nature of research and development, and the activity is no longer pursued, NASA generally retains the measure and does not reduce the target, but rather reflects this via a White rating. If emphasis is shifted onto a program for which there was no measure, NASA may choose to add a measure and rate it, to reflect the priority of that activity. Details on NASA's rating scales and criteria are in the Management and Performance Overview.

CHANGES TO THE FY 2012 PERFORMANCE PLAN

NASA corrected one annual performance goal in the FY 2012 Performance Plan and assigned White ratings to three measures. NASA justifies these performance plan changes below.

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Corrected Measure	Budget Account/ Program	Correction Made
5.4.1.2: SFS-12-3: Incorporate information sharing processes into programmatic policies and incorporate into crew demonstration addressing new entrant launch vehicle certification activities and future crew space transportation service contracts.	Human Exploration and Operations/ Launch Services	NASA updated the measure to reflect that the reference to crew space transportation partner information sharing, which would include other U.S. Government agencies, was incorrect, since none beyond NASA have crewed space flight. NASA's Launch Services Program partnership with the Department of Defense for space transportation is focused on launch vehicle certification of non-crewed flights, to the benefit of both organizations. NASA rated the measure after making the correction.

Measure Rated White	Budget Account/ Program	Rating Justification
2.4.2.2: JWST-12-1: Begin integration of James Webb Space Telescope (JWST) flight optics into Optical Telescope Element (OTE).	Science/ James Webb Space Telescope	The JWST Program replanning process resulted in a schedule revision that changed the milestone encapsulated in the FY 2012 measure. In the final review of the updated performance plan, NASA inadvertently missed correcting this measure to reflect the replan. The JWST Program continues to be on-track toward its revised plan.
6.3.1.1: AMO-12-20: Issue a competitive opportunity to engage the public in NASA's activities.	Cross Agency Support/ Agency Management & Operations	The original plan was for NASA to use the April 2012 OpenGov International Apps Challenge as the venue for a competitive opportunity for participatory engagement of the public. In 2012, the Office of Communications management determined that the participatory engagement resources would be better focused on leveraging other existing activities and redirected the funds planned for the competitive opportunity.

FY 2013 PERFORMANCE PLAN UPDATE

NASA submitted the FY 2013 Performance Plan with its FY 2013 Congressional Justification in February 2012. Since then, several factors, including typographical or other inaccuracies and changes to NASA's budget structure, have made it necessary to update the plan. Additionally, NASA's review of the FY 2013 and FY 2014 performance plans, within the context of performance trends seen for reported year of FY 2012 and spanning backward for up to five years, revealed several areas for improved and streamlined measurement. Specifically, NASA added several annual measures into the FY 2013 plan to ensure that both NASA and the public can see the trend from the past into future performance for key program areas.

NASA corrected nine annual performance goals after NASA published them in the FY 2013 Congressional Justification in February 2012. The table below provides the details of those corrections.

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Corrected Measure	Budget Account/ Program	Correction Made
APG 2.4.2.2: JWST-13-1: Initiate James Webb Space Telescope Backplane Support Frame Assembly. <i>Deliver James Webb Space Telescope Near Infrared Camera to Integrated Science Instrument Module (ISIM) Integration and Test.</i>	Science/ James Webb Space Telescope	The JWST Program replanning process resulted in a schedule revision that changed the milestone encapsulated in the FY 2013 measure. In the final review of the updated performance plan, NASA inadvertently missed correcting this measure to reflect the replan. The JWST Program continues to be on-track toward its revised plan.
APG ST-13-1: Research, study, or develop concepts for 400 120 technologies as documented in technology reports or plans.	Space Technology/ Crosscutting Space Technology Development	NASA increased the FY 2013 target based on the FY 2012 actual of 110 technologies documented in reports and plans and the anticipated number for FY 2013.
APG 3.2.1.1: ST-13-3: Implement at least one new small satellite spacecraft mission that was initiated in FY 2012 <i>selected in the previous fiscal year to</i> and demonstrate game changing or crosscutting technologies in space.	Space Technology/ Crosscutting Space Technology Development	Clarified the measurement to be made.
APG 3.2.1.1: ST-13-4: Implement at least three two Technology Demonstration Missions (TDM) technology development projects that were initiated in the previous two years.	Space Technology/ Crosscutting Space Technology Development	The solicitation for these missions had not been completed prior to the inclusion of the measure in the FY 2013 Congressional Justification. The final proposals selected were fewer than expected once the acquisition was completed.
APG 3.4.1.1: ST-13-6: Establish a total of two twelve partnerships with U.S. industry, other U.S. agencies, or other entities to develop technology that supports NASA's missions or national interests.	Space Technology/ Partnership Development and Strategic Integration	Typographical error corrected.
APG 4.1.1.1: AR-13-1: Conduct flight tests to characterize the ice crystal environment, which can adversely affect jet engine performance.	Aeronautics/Aviation Safety	This work was dependent on a contract that was discontinued due to unforeseen circumstances. As a result, NASA will not be able to complete a test flight in FY 2013 and has removed the associated FY 2013 APG from the performance plan. NASA and its partners are exploring opportunities for acquiring this important test data in the future.

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Corrected Measure	Budget Account/ Program	Correction Made
APG 5.4.2.1: SFS-13-3: Continue to establish and develop the 21 st Century Space Launch Complex (21 st CSLC) partnerships aimed at understanding government and commercial ground processing, launch, and range infrastructure requirements, while and implementing the modifications identified during the FY 2011 initiated studies.	Human Exploration and Operations/ 21 st Century Space Launch Complex	Clarified the measurement to be made.
5.4.3.1: SFS-13-4: Prepare TDRS L Pre-Ship for its Flight Readiness Review (FRR).	Human Exploration and Operations/ Space Communications and Navigation	Clarified the measurement to be made. The Pre-Ship Review is a milestone that ensures that the spacecraft is prepared for its Flight Readiness Review, which is scheduled to occur in FY 2013.
6.1.3.1: AMO-13-10: Provide equal opportunity (<i>EO</i>) assessment and technical assistance, or onsite compliance assessment <i>on-location</i> , at a minimum of two <i>STEM or</i> STEM-related programs that receive NASA funding.	Agency Management and Operations/ Office of Diversity & Equal Opportunity	Clarified the measurement to be made.

To improve performance trending within a multi-year performance goal, NASA has added the following annual performance goals to the FY 2013 plan:

- APG 1.1.2.1: ISS 13-5: Provide 100 percent of planned on-orbit resources (including power, data, crew time, logistics, and accommodations) needed to support research.
- APG 1.2.1.1: CS 13-2: Conduct a minimum of one commercial cargo demonstration flight of new cargo transportation systems, including proximity operations with ISS.
- APG 3.3.1.1: ERD-13-4: Assess the feasibility of a Multi-Purpose Logistics Module based habitation module to support human deep-space missions.
- APG 5.3.2.1: AR-13-9: Perform a condition assessment of the ground support facilities, systems, and equipment within the Flight Test Project portfolio.
- APG 5.4.3.1: SFS-13-4: Complete TDRS L Pre-Ship Review.
- APG 5.4.3.2: SFS-13-5: Complete Space Network Ground Segment Sustainment (SGSS) Critical Design Review (CDR).
- APG 5.4.3.3: SFS-13-6: Complete antenna structure for DSS-35 at the CDSCC.

Further discussion on measurement changes can be found in the combined annual performance report and plans contained in the next section, “NASA’s Combined Performance Report and Plan.”

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Performance–Budget Integration

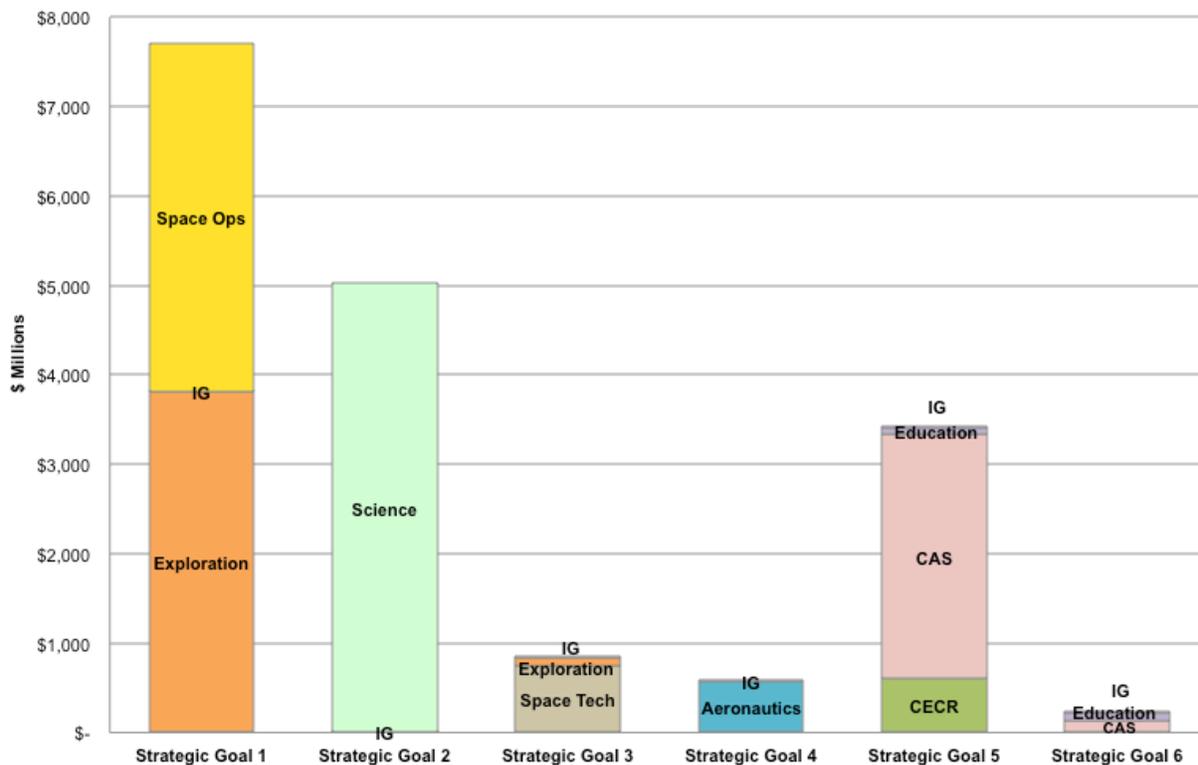
Performance-budget integration is the alignment of NASA’s strategic and performance plans with its planned investments. Each year, NASA checks the alignment by mapping its annual approved budget authority to its strategic goals. This process involves linking mission directorate, mission support, and education accounts, and their supporting programs, to their respective strategic goals.³ This performance-to-budget alignment is reinforced in the Agency’s annual performance plan that links each annual performance goal, and responsible program, to the strategic goals.

NASA shows strong performance-budget integration for FY 2014. The President’s FY 2014 budget request for NASA is \$17.7 billion through eight budget accounts. These accounts support NASA’s six strategic goals, outlined in detail in the [2011 NASA Strategic Plan](#). The strategic goals drive the mission priorities and activities within each account. In the FY 2014 Performance Plan, NASA plans numerous activities that further advance the Agency’s goals and contribute to national initiatives. Figure 2.1 maps the budget to strategic goals for FY 2014. Additional details on NASA’s FY 2014 Performance Plan are in the following section.

³ FY 2011 was the first year where mission support and education activities map directly to a strategic goal. In previous years, NASA allocated the budget for mission support and education activities across all strategic goals. The budget for the Office of Inspector General remains allocated across all strategic goals by an equal amount.

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Figure 2.1: FY 2014 Budget by Strategic Goal



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NASA's Combined Performance Report and Plan

Presenting the APR and APP information together allows a unique opportunity to see the trend across multiple years within a program and the tie between multi-year performance goals and the annual components of these. Multi-year performance trends are incorporated into the FY 2014 Performance Plan, starting with the currently reported year of FY 2012 and spanning backward for up to five years. NASA's method for trending multi-year performance data is to show the linkages between measures tracking similar data and annual progress for follow-on program activities. Linked measures, even if revised in subsequent years, are shown as related performance data. They are not meant to show back data for measures written exactly the same. In some cases, measures have been updated over the years to improve accuracy and data quality. For detailed information on performance ratings and measures from FY 2009 to FY 2011, go to <http://www.nasa.gov/news/budget/index.html>.

The combined report is organized by strategic goal, followed by an overview of each outcome. NASA summarizes FY 2012 performance for each multi-year performance goal, and whether there is planned performance against these in FY 2013 and/or FY 2014. The performance goal summary is followed by:

- The annual performance goals (APGs) associated with the performance goal;
- The FY 2012 ratings for both the performance goal and its supporting APGs and the performance for the past five fiscal years (if applicable);
- The annual performance plan for FY 2013 and FY 2014; and
- If an FY 2012 annual performance measure was not met, an explanation for why performance was less than planned.

Figure 2.2 below is an annotated sample from the combined APR/APP.

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Figure 2.2 APR/APP Sample

Reported Multi-Year Performance

Multi-Year Performance Goal 2.1.0.0: By 2015, launch at least two missions in support of objective 2.1.0.

FY11	The performance goal is to launch satellites in support of Earth Science Plan. NASA's Earth Science program outlines a portfolio of new missions, along with the design and development of an existing fleet of Earth observing spacecraft. Launching missions in a timely way increases scientific capabilities and helps maintain data continuity. Once the satellites are operating on orbit, NASA uses these assets for scientific research and a range of Earth-observing capabilities. Earth Science launched the first satellite supporting this performance goal, Aquarius, in June 2011. Aquarius will observe and year-to-year variations of sea-surface salinity and how these variations in the water cycle and ocean circulation, thereby influencing climate. In mission life, Aquarius will collect more sea surface salinity measurements than the entire 125-year historical record from ships and buoys.	Performance goal current and past ratings	Performance goal number and description
Green			
FY12			Explanation of performance goal and its rating
Green			

Update to Multi-Year Performance Goal		Changes, if any, to the performance goal in the FY13 or FY14 Performance Plans
FY13 Update	This performance goal remains the same in FY13	
FY14	This performance goal remains the same in FY14	

Reported Annual Performance						APG number and description
ES-12-0: Complete the Example Mission Systems Integration Review.						
Contributing Theme:		Earth Science				
Contributing Program(s):		Earth System Science Pathfinder				
FY07	FY08	FY09	FY10	FY11	FY12	
7ESS0 Green	8ES00 Yellow	9ES0 Green	10ES00 Green	ES-11-0 Green	ES-12-0 Yellow	
Why this APG was not achieved:						APG rating for FY12 and past 5 fiscal years
NASA delayed the SIR from September 2012 to November 2012 due to a potential problem with a widget subsystem. The contractor isolated the problem as a faulty component.						
Explanation for APG not rated Green						

Planned Annual Performance	
FY13 Update	Conduct Launch Readiness Review.
FY14	No APG in FY14

FY13 and FY14 Performance Plans for the APG

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Strategic Goal 1: Extend and sustain human activities across the solar system.

OUTCOME 1.1: SUSTAIN THE OPERATION AND FULL USE OF THE INTERNATIONAL SPACE STATION (ISS) AND EXPAND EFFORTS TO UTILIZE THE ISS AS A NATIONAL LABORATORY FOR SCIENTIFIC, TECHNOLOGICAL, DIPLOMATIC, AND EDUCATIONAL PURPOSES AND FOR SUPPORTING FUTURE OBJECTIVES IN HUMAN SPACE EXPLORATION.

The [International Space Station](#) is a major steppingstone in achieving NASA's exploration goals across the solar system. It is a space-based research and development laboratory to perform multidisciplinary, cutting-edge research. With assembly of ISS complete, the full-time crew of six can enable the on-going evolution of research and technology objectives and ensure that the benefits of this multinational investment can be realized.

This orbiting research laboratory allows NASA to develop, test, and validate the next generation of space technologies and operational processes needed to explore beyond low Earth orbit. It provides opportunities to address practical medical questions about astronaut health like mitigating the effects of long-term stays in space. The International Space Station supports an array of research in the biological and physical sciences necessary to advance knowledge and spaceflight capabilities. It also supports advanced engineering research and technology development for space exploration.

Under the auspices of a non-profit management organization, the [Center for Advanced Science in Space \(CASIS\)](#), NASA is making ISS available to other U.S. government agencies, university-based scientists and engineers, and private firms as a national resource for advancing basic and applied research in science and technology. CASIS is responsible for stimulating, developing, and managing a diversified research and development portfolio that will use the research facilities and environment aboard ISS to address U.S. needs.

Reported Multi-Year Performance

Multi-Year Performance Goal 1.1.1.1: Maintain capability for six on-orbit crew members.

FY11	NASA and its International Partners maintained the full six-person crew throughout FY 2012, except for the brief periods when ISS was staffed with the planned three crew during each scheduled Soyuz rotation, when the Russian spacecraft is taking crew to and from ISS. The ISS crewmembers were able to maintain the planned 35 crew hours per week throughout the year scheduled for utilization and were successful in supporting 100 percent of the planned research.
Green	
FY12	
Green	
	Part of maintaining the six-person crew is managing resources on board ISS. The crew reports the status of the resources, consumables, logistics, systems, and operational

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	procedures to the ISS Program Director and International Partners quarterly via the Space Station Control Board.
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Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
ISS-12-1: In concert with the International Partners, maintain a continuous six crew capability on the ISS by coordinating and managing resources, logistics, systems, and operational procedures.					
Contributing Theme:		International Space Station			
Contributing Program(s):		International Space Station			
FY07	FY08	FY09	FY10	FY11	FY12
7ISS5	8ISS06	9ISS6	10ISS07	ISS-11-1	ISS-12-1
Green	Green	Green	Green	Green	Green

Planned Annual Performance	
FY13 Update	ISS-13-1: In concert with International Partners, maintain a continuous six-crew capability on ISS by coordinating and managing resources, logistics, systems, and operational procedures.
FY14	ISS-14-1: In concert with International Partners, maintain a continuous six-crew capability on ISS by coordinating and managing resources, logistics, systems, and operational procedures.

Reported Multi-Year Performance

Multi-Year Performance Goal 1.1.1.2: HPPG: Safely fly out the Space Shuttle manifest and retire the fleet.

FY11	<p>This performance goal, created in FY 2010, had several important steps: complete the final flights of the Space Shuttle fleet; award the Orbiters and other artifacts to museums and educational and outreach institutions for public display; retire the Orbiters and prepare them for transport; and deliver the assets to their display locations. Using institutional funds, NASA continued to transfer or excess property, IT, systems, and records, with the goal of completing all tasks by the end of FY 2013. Some activities may continue beyond FY 2013.</p> <p>The Orbiter deliveries were major events that drew large crowds:</p> <ul style="list-style-type: none"> • On April 18, 2012, NASA ferried Space Shuttle Discovery by a modified Boeing 747 aircraft from the Kennedy Space Center in Florida, over the National Mall in downtown Washington, DC, and to the National Air and Space Museum’s Udvar-Hazy Center in Chantilly, Virginia. • After delivering Discovery to its new home, the Boeing 747 ferried Space Shuttle Enterprise, which had been on display at the Udvar-Hazy Center, to the John F. Kennedy International Airport on April 27. NASA placed the Orbiter on a barge and sailed it to a temporary display location on the deck of the Intrepid at Pier 87 in New York City on July 19. • The Space Shuttle Endeavour’s final ferry started September 19 at Kennedy Space Center and included a public display across the lower eastern United States. After NASA transported the Orbiter up to the Ames Research Center in the San Francisco Bay area for a
Green	
FY12	
Green	

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	<p>last flyover, NASA delivered Endeavour to Los Angeles International Airport on September 21. A 13.5-mile long parade took place in October as Endeavour traveled through the city streets from the airport to the California Science Center, where the Orbiter went on display.</p> <ul style="list-style-type: none"> • The Space Shuttle Atlantis moved to its final display location at the Kennedy Space Center Visitor Center in November 2012.
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Update to Multi-Year Performance Goal	
FY13 Update	No performance goal in FY13.
FY14	No performance goal in FY14.
Comments	After 30 years of Space Shuttle flights, NASA flew the last missions in FY 2011. The Space Shuttle Program completed the last major milestones in FY 2012 as part of program close out. Therefore, NASA is discontinuing performance measures for this program as of FY 2013.

Reported Annual Performance					
SSP-12-1: Ensure the Space Shuttle Discovery is ready for transport to its final display location.					
Contributing Theme:		Space Shuttle			
Contributing Program(s):		Space Shuttle			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	10SSP04 Green	SSP-11-1 Green	SSP-12-1 Green
Planned Annual Performance					
FY13 Update		No annual performance goal in FY13.			
FY14		No annual performance goal in FY14.			

Reported Multi-Year Performance

Multi-Year Performance Goal 1.1.1.3: Provide cargo and crew transportation to support on-orbit crew members and utilization.

FY11	<p>NASA completed all planned resupply flights during FY 2012. Furthermore, one of NASA's Commercial Space Transportation partners completed a major milestone. The final Space Exploration Technologies (SpaceX) demonstration flight launched on May 19, 2012, berthed to ISS and returned successfully on May 31. This flight represented the first commercial cargo launch to ISS, as well as the first autonomous ISS rendezvous by a U.S. spacecraft.</p> <p>The SpaceX demonstration flight was originally planned as two flights during FY 2012; however, SpaceX requested, and NASA approved, combining the two flights into one flight in December 2011. While SpaceX-1 could have been launched in September 2012, NASA delayed the mission until October due to previously scheduled activities aboard ISS during the fourth quarter of FY 2012. The ISS crew had to launch, dock, and undock the HTV3; undock the ATV3; undock the Soyuz 31 crew; launch and dock Progress 48; and conduct two spacewalks. After the ISS crew successfully executed all previously scheduled activities, SpaceX-1 launched on October 7.</p> <p>Orbital Science Corporation has a demonstration flight scheduled for 2013.</p>
Green	
FY12	
Green	

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Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
ISS-12-2: Fly the ISS spares, logistics, and utilization hardware as agreed to by the International Partners in the ISS transportation plan.					
Contributing Theme:		International Space Station			
Contributing Program(s):		International Space Station			
FY07	FY08	FY09	FY10	FY11	FY12
7ISS3 Green	8ISS03 Green	9ISS3 Green	10ISS03 Yellow	ISS-11-2 Green	ISS-12-2 Green
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	No annual performance goal in FY14.				
Comments	NASA has continually met its targets for flying spares, logistics, and utilization hardware with the exception of one Yellow-rated measure in FY 2010. In FY 2010, the performance measure also included flying ISS elements; technical issues delayed Shuttle missions and the delivery of some ISS elements, resulting in a Yellow rating. Due to the ISS Program's consistently good performance in this area, NASA is retiring this annual measure.				

Reported Annual Performance					
ISS-12-3: Complete at least two flights to the ISS by U.S.-developed cargo delivery systems.					
Contributing Theme:		International Space Station			
Contributing Program(s):		International Space Station			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	None	ISS-12-3 Green
Planned Annual Performance					
FY13 Update	ISS-13-2: Complete at least three flights, delivering research and logistics hardware to ISS, by U.S.-developed cargo delivery systems.				
FY14	ISS-14-2: Complete at least three flights, delivering research and logistics hardware to ISS, by U.S.-developed cargo delivery systems.				

Reported Multi-Year Performance

Multi-Year Performance Goal 1.1.1.4: Maintain and operate a safe and functional ISS.

FY11	The International Space Station Program maintained its stellar record of safety and functionality through FY 2012. A fully functional ISS means that ISS systems and elements are working and available to support the research plan. Regularly scheduled repair and maintenance tasks ensure the health and safety of the vehicle. The Space Station Control Board reviews ISS systems, operations, consumables, resources, and transportation status quarterly to ensure that ISS is fully functional.
Green	
FY12	
Green	

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Update to Multi-Year Performance Goal	
FY13 Update	No performance goal in FY13.
FY14	No performance goal in FY14.
Comments	NASA maintains the intent of this performance goal, the safety and functionality of ISS, as top priorities for the ISS Program. Now that NASA and international partners have completed construction of ISS, and the program has shifted its focus to full utilization, this performance goal is no longer necessary for NASA management. NASA has realigned its remaining APG to performance goal 1.1.2.1, which NASA has rewritten to focus on the major areas for ISS utilization.

Reported Annual Performance					
ISS-12-5: Achieve zero Type-A (damage to property at least \$1 million or death) or Type-B (damage to property at least \$250 thousand or permanent disability or hospitalization of three or more persons) mishaps.					
Contributing Theme:		International Space Station			
Contributing Program(s):		International Space Station			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	10ISS05 Green	ISS-11-4 Green	ISS-12-5 Green
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	No annual performance goal in FY14.				

Reported Multi-Year Performance

Multi-Year Performance Goal 1.1.2.1: Advance knowledge of long-duration human space flight by establishing agreements with organizations to enable full utilization of the ISS.

FY11	Research on ISS continues to advance science and technology knowledge. The ISS international partner team published the International Space Station Benefits for Humanity document in February 2012, to provide examples of the ISS groundbreaking scientific research in human health, Earth observation and disaster response, and global education. This document summarizes the scientific, technological, and educational accomplishments of the many international and domestic organizations utilizing ISS.
Green	
FY12	NASA and CASIS fully supported the first annual ISS Research and Development Conference , held from June 26 to 28, 2012, in Denver, Colorado. The conference provided a forum for current ISS researchers to provide results (presentations available from the American Astronautical Society) of their research and for potential researchers to learn about the opportunities available to perform research on ISS. Over 400 participants attended the meeting to learn how to meet NASA's goal of full utilization of ISS to advance scientific knowledge and prepare for long-duration spaceflight.
Green	
	CASIS continues to make progress in accomplishing the metrics documented in their 2012 Annual Program Plan and meeting the obligations in the Cooperative Agreement. The ISS team is continuing to transfer non-NASA partnership agreements to the CASIS organization

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	as planned in the Cooperative Agreement. The CASIS team used the ISS Research and Development Conference to meet with potential researchers and funding sources. All future partnership agreements will be the responsibility of the CASIS management team.
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Update to Multi-Year Performance Goal	
FY13 Update	Maintain a safe and functional ISS national laboratory and utilize it to advance engineering, technology, and science research.
FY14	This performance goal remains the same in FY14.
Comments	As of FY 2013, NASA has broadened this performance goal to reflect the scope of work realigned underneath it. NASA moved the APG that was under performance goal 1.1.1.4 to this revised performance goal.

Reported Annual Performance					
ISS-12-4: Provide 100 percent of planned on-orbit resources (including power, data, crew time, logistics, and accommodations) needed to support research.					
Contributing Theme:		International Space Station			
Contributing Program(s):		International Space Station			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	10ISS08 Green	ISS-11-3 Green	ISS-12-4 Green
Planned Annual Performance					
FY13 Update	ISS-13-5: Provide 100 percent of planned on-orbit resources (including power, data, crew time, logistics, and accommodations) needed to support research.				
FY14	No annual performance goal in FY14.				

Reported Annual Performance					
ISS-12-6: Accomplish a minimum of 90 percent of the on-orbit research objectives, as baselined by NASA and ISS Non-profit organization (NPO).					
Contributing Theme:		International Space Station			
Contributing Program(s):		International Space Station			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	ISS-11-5 Green	ISS-12-6 Green
Planned Annual Performance					
FY13 Update	ISS-13-3: Accomplish a minimum of 90 percent of the on-orbit research and technology development objectives. Objectives are baselined by NASA and the ISS Non-profit organization one month prior to each increment, which is the time period between crew rotations.				
FY14	ISS-14-3: Accomplish a minimum of 90 percent of the on-orbit research and technology development objectives. Objectives are baselined by NASA, ISS non-profit organization, and the ISS Technology Demonstration Office one month prior to each increment, which is the time period between crew rotations.				

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Reported Annual Performance	
No annual performance goal in FY12 or trended performance.	
Contributing Theme:	International Space Station
Contributing Program(s):	International Space Station
Planned Annual Performance	
FY13 Update	ISS-13-4: Fully utilize ISS by ensuring that at least 75 percent of the research sites available are used.
FY14	ISS-14-4: Ensure that at least 80 percent of the research sites available are used.

Reported Multi-Year Performance

Multi-Year Performance Goal 1.1.2.2: Conduct basic and applied biological and physical research to advance and sustain U.S. scientific expertise.

FY11	<p>Operations continued for the investigations in the Combustion and Fluids Racks, the Microgravity Science Glovebox (MSG), and the Materials Science Research Rack on ISS. Crewmembers conducted several physical sciences experiments, including the Flame Extinguishment Experiment (FLEX-2), the Structure and Liftoff In Combustion Experiment (SLICE), the Capillary Flow Experiment-2 (CFE-2), the Binary Colloidal Alloy Test-6 (BCAT-6), and the Advanced Colloids Experiment-1 (ACE-1).</p> <p>During the fourth quarter of the fiscal year, NASA released a solicitation for research in space biology, to design concepts for ISS capabilities now in development.</p>
Green	
FY12	
Green	

Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
ISS-12-7: Conduct flight definition review for at least five flight experiments in fundamental space biology.					
Contributing Theme:		International Space Station			
Contributing Program(s):		International Space Station			
FY07	FY08	FY09	FY10	FY11	FY12
None	8AC02 Green	9AC3 Green	10AC03 Green	ERD-11-1 Green	ISS-12-7 Green
Planned Annual Performance					
FY13 Update	ISS-13-6: Conduct flight definition reviews for at least five flight experiments in fundamental space biology that were selected through a NASA Research Announcement.				
FY14	ISS-14-5: Complete all pre-flight activities and be ready to support the launch of the first flight with animals.				

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Reported Annual Performance					
ISS-12-8: Deliver at least two physical sciences payloads for launch to the ISS.					
Contributing Theme:		International Space Station			
Contributing Program(s):		International Space Station			
FY07	FY08	FY09	FY10	FY11	FY12
None	8AC01 Green	9AC1 Green	10AC01 Green	ERD-11-2 Green	ISS-12-8 Green
Planned Annual Performance					
FY13 Update	ISS-13-7: Deliver at least four physical sciences payloads for launch to ISS.				
FY14	No annual performance goal in FY14.				

Reported Annual Performance					
ISS-12-9: Conduct at least five experiments in combustion, fluids, or materials sciences on the ISS.					
Contributing Theme:		International Space Station			
Contributing Program(s):		International Space Station			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	9AC2 Green	10AC02 Green	ERD-11-3 Green	ISS-12-9 Green
Planned Annual Performance					
FY13 Update	ISS-13-8: Conduct at least six experiments in combustion, fluids, or materials sciences on ISS.				
FY14	No annual performance goal in FY14.				
Comments	NASA is revisiting the performance measurement strategy for this program and will add any new measures for FY 2014 during the development of FY 2015 Performance Plan.				

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OUTCOME 1.2: DEVELOP COMPETITIVE OPPORTUNITIES FOR THE COMMERCIAL COMMUNITY TO PROVIDE BEST VALUE PRODUCTS AND SERVICES TO LOW EARTH ORBIT AND BEYOND.

Commercial space transportation is a vital component to the future of human space exploration. As NASA charts a new course to send humans deeper into space than ever before, it also is stimulating efforts with the private sector to develop and operate safe, reliable, and affordable commercial low Earth orbit transportation systems. NASA will purchase commercial services to transport crew and cargo to the International Space Station and low Earth orbit as capabilities mature and become available to the government and other customers. NASA is investing financial and technical resources to stimulate efforts within the private sector to develop and demonstrate safe, reliable, and cost-effective space transportation capabilities. NASA currently manages one [Commercial Orbital Transportation Services \(COTS\)](#) Space Act Agreement (SAA) with Orbital Sciences Corporation (Orbital) for cargo transportation capabilities development and demonstration. A second SAA between NASA and SpaceX has concluded with the successful demonstration flight of the SpaceX Dragon spacecraft to and from ISS. Through [Commercial Crew Development \(CCDev\)](#), NASA is aiding development and demonstration of crew transportation capabilities.

Reported Multi-Year Performance

Multi-Year Performance Goal 1.2.1.1: Develop competitive opportunities for the commercial community to provide best value products and services to low Earth orbit and beyond.

FY11	<p>NASA is nearing completion of the second round of the Agency’s CCDev-2 initiative, a partnership that advanced participants’ crew transportation system concepts and matured the design and development of elements of their systems. CCDev-2 partners included:</p> <ul style="list-style-type: none"> • Blue Origin, maturing the Space Vehicle design, pusher escape system, and accelerating engine development for their Reusable Booster System; • Sierra Nevada Corporation, maturing the Dream Chaser crew spacecraft; • SpaceX, maturing an integrated, side-mounted launch abort system for the crewed Dragon Spacecraft; and • The Boeing Company, maturing the CST-100 crewed spacecraft design and development. <p>In August, the Agency signed Space Act Agreements for the next phase of commercial crew development, the Commercial Crew integrated Capability (CCiCap). Partners for this initiative include Sierra Nevada Corporation, The Boeing Company, and SpaceX. During this effort, industry partners will develop crew transportation capabilities as fully integrated systems. Between now and May 31, 2014, partners will perform tests and mature integrated designs, setting the stage for a future activity that will launch crewed orbital demonstration missions to low Earth orbit by the middle of the decade.</p> <p>On May 31, 2012, SpaceX successfully completed their final COTS demonstration mission to ISS, completing all test objectives. Orbital is scheduled to complete a COTS demonstration mission to ISS next year, concluding development and demonstration of its cargo transportation system to low Earth orbit.</p>
Green	
FY12	
Green	

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Update to Multi-Year Performance Goal	
FY13 Update	Invest financial and technical resources to stimulate efforts within the private sector to develop and demonstrate safe, reliable, and cost-effective space transportation capabilities.
FY14	This performance goal remains the same in FY14.
Comments	NASA has broadened this performance goal to encompass all types of resources that the Agency offers to the commercial space community. In FY 2014, NASA will retire performance goal 1.2.1.2 and realign activities related to certification processes under this performance goal.

Reported Annual Performance					
CS-12-1: Perform Commercial Orbital Transportation Services (COTS) cargo demonstration missions and continue commercial crew transportation systems development.					
Contributing Theme:		Commercial Spaceflight			
Contributing Program(s):		Commercial Cargo			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	CS-11-4 Green	CS-12-1 Green
Planned Annual Performance					
FY13 Update	CS-13-2: Conduct a minimum of one commercial cargo demonstration flight of new cargo transportation systems, including proximity operations with ISS.				
FY14	No annual performance goal in FY14.				

Reported Annual Performance					
No annual performance goal in FY12.					
Contributing Theme:		Commercial Spaceflight			
Contributing Program(s):		Commercial Crew			
FY07	FY08	FY09	FY10	FY11	FY12
None	8CS08 Yellow	9CS9 Yellow	10CS07 Yellow	CS-11-2 Yellow	None
Planned Annual Performance					
FY13 Update	CS-13-1: Execute Space Act Agreements (SAAs) for development of a commercial Crew Transportation System (CTS).				
FY14	CS-14-1: Complete the Commercial Crew Certification Products Contracts that will provide key information on how a commercial crew transportation system can meet NASA certification requirements.				
FY14	CS-14-2: Award the second phase Commercial Crew Transportation System certification contracts.				

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Reported Multi-Year Performance

Multi-Year Performance Goal 1.2.1.2: Develop and document evaluation and certification processes for an integrated commercial crew transportation system.

FY11	<p>NASA developed and released baseline versions of the CCT-1100 series of documents in December 2011. These documents communicate roles and responsibilities, technical management processes supporting certification, crew transportation system and ISS services requirements, ISS interface requirements, and the application of technical and operations standards for potential commercial providers. NASA’s overarching strategy for the development of these documents is to ensure the requirements meet the Agency’s safety and performance standards. NASA also wants to avoid being overly prescriptive, allowing commercial industry maximum flexibility to develop safe, reliable, and cost-effective human space transportation systems.</p> <p>NASA has defined its certification plan and updated its strategy for award of Federal Acquisition Regulations (FAR)-based contracts for the certification phase for commercial crew transportation. In parallel with the announcement of the CCiCAP awards, NASA announced that it would undertake a competitive two-phased acquisition for NASA crew transportation system certification. Under the certification contracts, NASA will manage the certification process to ensure that commercial partners have met NASA requirements in their certification plans.</p> <p>Crew transportation system certification Phase 1, referred to as Certification Products Contract(s) , will begin in January 2013 and will be limited to submittal and technical disposition of the following specific, early lifecycle certification products: Alternate Standards, Hazard Analyses, a Certification Plan, and a Verification and Validation Plan. At the conclusion of the phase, NASA anticipates that more than one commercial provider will have achieved the technical maturity of an integrated design state to enable a Phase 2 competition for the crew transportation system certification contract. Under NASA’s planned strategy, the scope of the certification contract will include development, test, evaluation, and certification activities enabling NASA to assess the crew transportation system capability for performing ISS missions in compliance with NASA requirements. This will ensure NASA mission and safety objectives are achieved.</p>
Green	
FY12	
Green	

Update to Multi-Year Performance Goal	
FY13 Update	No performance goal in FY13.
FY14	No performance goal in FY14.
Comments	NASA is eliminating this performance goal and moving certification activities to performance goal 1.2.1.1. Evaluation and certification are key processes in the development of commercial crew transportation systems. By providing evaluation and certification processes, NASA helps the commercial community develop and demonstrate space transportation technologies.

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Reported Annual Performance					
CS-12-2: Baseline ISS Crew Transportation and Service Requirements document, CTS-REQ-1130, and Crew Transportation Technical Standards and Design Evaluation Criteria document, CCT-STD-1140.					
Contributing Theme:		Commercial Spaceflight			
Contributing Program(s):		Commercial Crew			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	CS-11-5 Green	CS-12-2 Green
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	No annual performance goal in FY14.				

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OUTCOME 1.3: DEVELOP AN INTEGRATED ARCHITECTURE AND CAPABILITIES FOR SAFE CREWED AND CARGO MISSIONS BEYOND LOW EARTH ORBIT.

Exploration beyond low Earth orbit will span decades, with the first steps being the development of solid groundwork to ensure a successful endeavor. Experienced personnel from across the Agency are building a set of architectures, or mission frameworks, for multiple destinations in the solar system. These architectures include all aspects of mission performance that define the knowledge, capabilities, and infrastructure necessary to support human space exploration. Those aspects include technologies, partnerships, safety, risk assessment and reduction, schedule management, operations, and stakeholder priorities.

Reported Multi-Year Performance

Multi-Year Performance Goal 1.3.1.1: Complete design reviews for Space Launch System (SLS).

FY11	<p>The SLS Program, NASA's program to develop an advanced, heavy-lift launch vehicle for exploration beyond Earth's orbit, is on target to complete design reviews for the uncrewed test flight, Exploration Mission (EM)-1. Information provided at monthly Program Management Reviews supports the existing launch date, as well as scheduled design reviews. Management combined the SLS system requirements review (SRR) with its system definition review (SDR), and conducted the combined review into two steps. Step 1 was an extensive technical review that was successfully completed on March 29, 2012. Step 2 was an internal in-depth business review that occurred May 17, 2012. Step 2 led to formal input from the standing review board. The standing review board's results, along with SLS responses, of the cost, technical, schedule, and risk status were presented to the Agency on June 29, 2012. Space Launch System completed its internal SRR and SDR program review, and on July 25, 2012, the program progressed to Phase B, which is the preliminary design and formulation phase.</p> <p>The SLS Program also completed the Core Stage SRR and SDR board on June 15, 2012, allowing Core Stage work to progress from Phase A (concept development) into Phase B (preliminary design and formulation).</p>
Green	
FY12	
Green	

Update to Multi-Year Performance Goal	
FY13 Update	Complete design reviews for the Space Launch System (SLS) and make progress on system development toward a first uncrewed test flight in 2017 and first crewed flight in 2021.
FY14	This performance goal remains the same in FY14.
Comments	NASA broadened the language of this performance goal to reflect the greater scope of work for this program and to clarify what the annual measures are targeting.

Reported Annual Performance					
ESD-12-1: Successfully complete the Space Launch System (SLS) Systems Requirements Review (SRR).					
Contributing Theme:		Exploration Systems and Development			
Contributing Program(s):		Space Launch System			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	HEC-11-1 Green	ESD-12-1 Green

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Planned Annual Performance	
FY13 Update	ESD-13-1: Complete the SLS Preliminary Design Review (PDR) and establish the technical design, cost, and schedule baseline for the SLS first flight.
FY14	ESD-14-1: Complete the Qualification Motor (QM-2) Test, and use the data from the test to support the SLS Program Critical Design Review.

Reported Multi-Year Performance

Multi-Year Performance Goal 1.3.1.2: Complete design reviews for Orion Multi-Purpose Crew Vehicle (MPCV).

FY11	<p>The Orion MPCV Program is on target to complete design reviews for Exploration Flight Test (EFT)-1, the first planned uncrewed test flight of the Orion MPCV, and Exploration Mission (EM)-1. Information provided at monthly Program Management Reviews supports the existing launch dates, as well as scheduled design reviews. MPCV is on track to conduct a Key Decision Point (KDP)-B review in late July 2012, with final KDP-B approval in fall 2012.</p> <p>In January 2012, Orion-MPCV successfully completed testing of the Ground Test Article. NASA used the Ground Test Article, which is representative of the Orion MPCV, to test if the capsule would turn right side up after a water landing and whether the structure would withstand the impact. NASA also completed the welding of the EFT-1 primary structure, the crew module that will be used as the test article for EFT-1.</p>
Green	
FY12	
Green	

Update to Multi-Year Performance Goal	
FY13 Update	Complete design reviews for Orion Multi-Purpose Crew Vehicle (MPCV) and make progress on system development toward a first uncrewed test flight in 2017 and first crewed flight in 2021.
FY14	This performance goal remains the same in FY14.
Comments	NASA broadened the language of this performance goal to reflect the greater scope of work for this program and to clarify what the annual measures are targeting.

Reported Annual Performance					
ESD-12-2: Complete testing of Orion Multi-Purpose Crew Vehicle (MPCV) Ground Test Article (GTA).					
Contributing Theme:			Exploration Systems and Development		
Contributing Program(s):			Orion Multi-Purpose Crew Vehicle		
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	HEC-11-2 Green	ESD-12-2 Green
Planned Annual Performance					
FY13 Update	ESD-13-2: Manufacture Orion Multi-Purpose Crew Vehicle (MPCV) flight test hardware required for initial integration testing for the Exploration Flight Test 1 (EFT-1).				
FY14	ESD-14-2: Complete Orion/MPCV manufacturing and assembly so the spacecraft is ready for launch vehicle integration for the Exploration Flight Test 1 (EFT-1).				

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Reported Multi-Year Performance

Multi-Year Performance Goal 1.3.2.1: Develop technologies that will enable biomedical research and mitigate health risks associated with human space exploration missions.

FY11	<p>The Human Research Program (HRP) made several significant contributions to the knowledge base for safer exploration missions in FY 2012. A NASA research project, Man-Machine Integration Design and Analysis System–Function Allocation Simulation Tool (MIDAS-FAST), demonstrated software that enables users to predict the effects of different types of robotics system automation on performance. This project contributes to mitigating the risks associated with human automation–robotic interaction. In addition, HRP met a critical milestone with the submission of the final report on the Sleep-Wake Actigraphy Study–Risk Characterization and Monitoring Tools for Spaceflight Environments of Shuttle and ISS. This investigation is the largest study of sleep in spaceflight for both short and long-duration missions, and directly addresses HRP spaceflight-related research gaps by providing objective data collected from ISS crewmembers (3,201 ISS in-flight days) and astronauts on 80 Shuttle missions, encompassing 26 STS flights (1,066 STS in-flight days).</p> <p>Also, in August 2012, HRP selected 12 proposals for funding through the 2012 NASA Research Announcement (NRA) for Ground-Based Studies in Space Radiation. NASA and the National Space Biomedical Research Institute received 157 proposals in response to the NRA for Research and Technology Development to Support Crew Health and Performance in Space Exploration Missions.</p>
Green	
FY12	
Green	

Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	Conduct biomedical research and demonstrate technologies that will mitigate health risks associated with human space exploration missions.

Reported Annual Performance					
ERD-12-1: Develop and release two NASA Research Announcements that solicit from the external biomedical research community the highest quality proposals to mitigate space human health risks.					
Contributing Theme:		Exploration Research and Development			
Contributing Program(s):		Human Research			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	ERD-11-4 Green	ERD-12-1 Green
Planned Annual Performance					
FY13 Update	ERD-13-1: Complete two ISS physiological flight experiments that define requirements for maintaining astronaut health for long-duration missions.				
FY14	ERD-14-1: Complete two space radiation national research campaigns at the NASA Space Radiation Laboratory at Brookhaven National Laboratory.				

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Reported Multi-Year Performance

Multi-Year Performance Goal 1.3.2.2: Perform research to ensure that future human crews are protected from the deleterious effects of space radiation.

FY11	In August 2012, HRP selected 12 proposals for funding through the 2012 NASA Research Announcement for Ground-Based Studies in Space Radiation. Acute radiation risks from large solar particle events are a major risk to crew health. NASA uses a specific software tool to evaluate acute risks, support mission operational planning and spacecraft shielding design. NASA released the Version 2 beta of this tool in May 2012 and the final version in June 2012.
Green	
FY12	
Green	

Update to Multi-Year Performance Goal	
FY13 Update	No performance goal in FY13.
FY14	No performance goal in FY14.
Comments	The Human Research Program will continue to pursue this important area of research. For FY 2014, NASA is reducing the number of performance goals dedicated to biomedical research for human spaceflight and focusing and strengthening the remaining performance goal. The work planned toward this performance goal, dedicated to protecting crews from space radiation, has been realigned to a broadened performance goal 1.3.2.1. To reflect this, NASA moved the subordinate APGs to this performance goal.

Reported Annual Performance					
ERD-12-2: Release Acute Radiation Risk Model Version 2 to assess effects of solar particle events during exploration missions.					
Contributing Theme:		Exploration Research and Development			
Contributing Program(s):		Human Research			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	ERD-11-5 Green	ERD-12-2 Green
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	No annual performance goal in FY14.				

Reported Multi-Year Performance

Multi-Year Performance Goal 1.3.2.3: Develop exploration medical capabilities for long-duration space missions.

FY11	In July 2012, the Integrated Cardiovascular experiment was able to collect for the first time exercise echocardiography data while a crewmember was exercising on the Cycle Ergometer with Vibration Isolation and Stabilization (CEVIS) in the U.S. Laboratory. The portable Ultrasound 2 hardware made this possible. The integrated monitoring and diagnostics capabilities of CEVIS and Ultrasound 2 are a significant advance in cardiac research and diagnosis for space medicine.
Green	
FY12	
Green	
	In January 2011, the original ultrasound aboard ISS failed. HRP was developing Ultrasound 2, which was scheduled for launch to ISS in FY 2012. The HRP teams at the Ames Research Center and Johnson Space Center accelerated the development and testing, and

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	launched the device on STS-135 in July 2011.
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Update to Multi-Year Performance Goal	
FY13 Update	No performance goal in FY13.
FY14	No performance goal in FY14.
Comments	The Human Research Program will continue to pursue this important area of research. For FY 2014, NASA is reducing the number of performance goals dedicated to biomedical research for human spaceflight and focusing and strengthening the remaining performance goal. NASA realigned the work planned toward this performance goal, dedicated to exploring medical capabilities for long-term space flight, to a broadened performance goal 1.3.2.1. To reflect this, NASA moved the subordinate APGs to this performance goal.

Reported Annual Performance					
ERD-12-3: Deliver the next-generation space biomedical ultrasound device to enhance the Human Research Facility capability on the ISS through 2020.					
Contributing Theme:		Exploration Research and Development			
Contributing Program(s):		Human Research			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	9AC5 Yellow	10AC07 Green	ERD-11-6 Green	ERD-12-3 Green
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	No annual performance goal in FY14.				

Reported Multi-Year Performance

Multi-Year Performance Goal 1.3.3.1: Prioritize the knowledge of hazards, opportunities, and potential destinations for human space exploration that will be of use to future operations of an integrated architecture for human space exploration.

FY11	In collaboration with the Planetary Science Division of NASA's Science Mission Directorate, the Advanced Exploration Systems Program developed and presented a preliminary plan on the development of human spaceflight architectures to the Office of Management and Budget on October 24, 2011. NASA identified areas in which more knowledge was required for each potential human destination (the Moon, cis-lunar space, near-Earth asteroids, and Mars). NASA then developed a plan to vet these strategic knowledge gaps with the science and exploration communities and to prioritize them. NASA's will use the skills and knowledge gaps as a basis for investment decisions made by multiple stakeholders. By developing an integrated set of priorities, NASA will leverage mission opportunities, data, and the talents of both the exploration and science communities to enable human missions.
None	
FY12	
Green	

Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

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Reported Annual Performance					
ERD-12-4: In collaboration with the Planetary Science Division, develop a plan to return data that will support the selection of destinations and reduce risk for future human space exploration missions.					
Contributing Theme:		Exploration Research and Development			
Contributing Program(s):		Advanced Exploration Systems			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	None	ERD-12-4 Green
Planned Annual Performance					
FY13 Update	ERD-13-2: Develop a set of strategic knowledge gaps on potential destinations for human spaceflight, facilitate external advisory group review of the gaps and document the results in the Global Exploration Roadmap.				
FY14	ERD-14-2: Complete the Preliminary Design Review (PDR) for a robotic precursor mission to prospect for lunar ice.				

Reported Annual Performance	
No annual performance goal in FY12 or trended performance.	
Contributing Theme:	Exploration Research and Development
Contributing Program(s):	Advanced Exploration Systems
Planned Annual Performance	
FY13 Update	No annual performance goal in FY13.
FY14	ERD-14-3: Fabricate and test a proof of concept asteroid capture mechanism.

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Strategic Goal 2: Expand scientific understanding of the Earth and the universe in which we live.

OUTCOME 2.1: ADVANCE EARTH SYSTEM SCIENCE TO MEET THE CHALLENGES OF CLIMATE AND ENVIRONMENTAL CHANGE.

The Earth system, like the human body, comprises diverse components that interact in complex ways. To understand the Earth system means understanding how Earth's atmosphere, lithosphere, hydrosphere, cryosphere, and biosphere as a single connected system. It also means understanding how the planet is changing on all spatial and temporal scales.

The purpose of NASA's Earth science program is to develop a scientific understanding of Earth's system and its response to natural or human-induced changes and to improve prediction of climate, weather, and natural hazards. The [Earth Science Division](#) uses a balanced portfolio of flight programs, research, technology development, and applied sciences to achieve its objectives and serve national and international needs in these areas. Earth Science partners with the [National Oceanic and Atmospheric Administration \(NOAA\)](#), the [U.S. Geological Survey](#), and other Federal government agencies, local government, universities, international agencies, and others to provide science data products and applications that enable policy, business, and management decisions.

Providing National Scientific Capabilities for Earth Science

NASA continues to develop the Nation's capabilities in support of this science objective by funding research and mission development performed by scientists and engineers at universities, research centers, the private sector, and NASA Centers. The vast majority of research awards also include funding for postdoctoral fellows, graduate students, and undergraduate students, thereby supporting the education and training of future scientists and engineers.

Programs and activities serving this goal in FY 2012 include:

- A broad based research program that is focused on global and environmental change, and the advancement of Earth System Science.
- The [Airborne Science Program](#), which conducted over 3,000 flight operation hours and 20 missions in support of NASA's Earth science program during FY 2012, involved 129 undergraduate and 229 graduate students who directly participated in Airborne Science investigations and student-led flight projects. NASA Airborne Science platforms were actively engaged in mission definition activities, instrument development flights, gathering ice sheet observations as gap fillers, and satellite calibration and validation. Development of a Global Earth System Model capable of making multi-decadal projections of climate change.
- Development of a Global Data Assimilation System capable of integrating multiple sources of observations.
- Graduate fellowships through the New Investigator Program, the NASA Earth System Science

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Fellowships program, NASA Post Doctoral Program and Presidential Early Career Award for Scientists and Engineers.

- NASA wide supercomputing capability to support scientific discovery, space exploration, and aeronautic research.
- Support, enhancement, and continuing use of a worldwide array of ground-based atmosphere observation networks.
- Continued operation of the U.S. contribution to the International Global Geodetic Networks and development of the next generation geodetic station prototype.

NASA's Earth Science continued to operate 15 Earth-orbiting satellites employing a total of 78 distinct instruments. These included the [Active Cavity Radiometer Irradiance Monitor Satellite \(ACRIMSAT\)](#), [Aqua](#), [Aquarius/SAC-D](#), [Aura](#), the [Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation \(CALIPSO\)](#), [CloudSat](#), [Earth Observing \(EO\)-1](#), the [Gravity Recovery and Climate Explorer \(GRACE\)](#), [Jason-1](#), [Landsat-7](#), [QuikSCAT](#), the [Solar Radiation and Climate Experiment \(SORCE\)](#), [Suomi National Polar-orbiting Partnership \(NPP\)](#), [Terra](#), and the [Tropical Rainfall Measuring Mission \(TRMM\)](#). Earth Science makes comprehensive global data sets openly available, some in near-real time, via direct broadcast infrastructure. These make crucial contributions to researchers, first responders, weather forecasters, and decision makers.

The [Earth Observing System Data and Information System \(EOSDIS\)](#) project provides science data to a wide community of users, including NASA, Federal agencies, international partners, academia, and the public. EOSDIS provides users with the services and tools they need in order to use NASA's Earth science data in research and creation of models. EOSDIS archives and distributes data through standardized science data products, using algorithms and software developed by Earth Science investigators. This project funds the Elements of EOSDIS Evolution, aimed at improving the efficiency and effectiveness of EOSDIS while reducing the cost. It also supports the eight nationwide Distributed Active Archive Centers (DAAC) installations that collect, disseminate, and archive Earth science data. Each DAAC focuses on a specific Earth system science discipline and provides users with data products, services, and data-handling tools unique to that specialty.

NASA requires that all funded research investigations publish their results in open, peer reviewed science literature, ensuring that data and knowledge are captured. Each year, the Earth Science Subcommittee of NASA's external advisory Science Committee evaluates the progress made by NASA toward each science objective. In FY 2012, the subcommittee found that expectations had been fully met by research results leading to major scientific findings and discoveries, and major accomplishments.

PERFORMANCE REPORTING AND PLANNING

Reported Multi-Year Performance

Multi-Year Performance Goal 2.1.1.1: Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base. (In support of objective 2.1.1: "Improve understanding of and improve the predictive capability for changes in the ozone layer, climate forcing, and air quality associated with changes in atmospheric composition.")

FY11	<p>In the past year, NASA researchers participated in multiple Earth Venture-1 funded suborbital missions, including the Airborne Tropical Tropopause Experiment (ATTREX), Deriving Information on Surface Conditions from Column and Vertically Resolved Observations Relevant to Air Quality (DISCOVER-AQ), and the Carbon in Arctic Reservoirs Vulnerability Experiment (CARVE). Preliminary analyses of DISCOVER-AQ observations over the Baltimore–Washington corridor suggest that the expectation of a well-mixed boundary layer is often incorrect and that each pollutant can have a different vertical distribution. CARVE, which conducted its first science flights during May and June 2012, is designed to quantify correlations between atmospheric concentrations of carbon dioxide and methane with surface-atmosphere carbon fluxes and surface state control variables (soil moisture, freeze-thaw state, inundation state, and surface soil temperature) and clarify the sensitivities of Arctic carbon cycle processes to climate change.</p> <p>NASA researchers participated in several internationally coordinated activities to advance the state of knowledge of atmospheric ozone measurements and theory. Under the auspices of the World Climate Research Programme (WCRP) Stratosphere-troposphere Processes And their Role in Climate (SPARC) program, researchers are assessing and extending the current knowledge and understanding about measurements of the vertical distribution of ozone, with the aim of providing input to the next World Meteorological Organization Scientific Assessment of Ozone Depletion, anticipated for 2014. The SPARC Reassessment of Lifetimes of Long-Lived Atmospheric Trace Gas Lifetime Crucial to Ozone Depletion and Climate Change, co-led by NASA researchers, is reviewing estimates of the lifetimes of key atmospheric molecules crucial to understanding current and future atmospheric concentrations of ozone depleting substances and greenhouse gases.</p> <p>Using measurements from instruments aboard the Aura satellite Microwave Limb Sounder (MLS) and Ozone Monitoring Instrument (OMI), researchers found that the chemical ozone destruction over the Arctic in early 2011 was—for the first time in the observational record—comparable to that in the Antarctic ozone hole. Significant Arctic ozone loss was found to occur even with temperatures much milder than those in the Antarctic. However, it is still difficult to predict when such severe Arctic ozone depletion may be matched or exceeded.</p> <p>Numerous studies across the focus area continue to assess and improve the predictive capability of models for changes in composition, climate forcing and air quality. For example, multiple data sets, mostly from satellite observations (acquired by the Tropospheric Emission Spectrometer [TES] and MLS), were used to evaluate the performance of the Weather Research and Forecasting model with Chemistry (WRF-Chem) in simulating the distribution and evolution of aerosol, clouds, precipitation, and chemistry during the dry season in South America. The study demonstrated that satellite data are valuable to the evaluation of regional model simulations for climatologically important processes such as deep convection and biomass burning, especially in regions with little in situ observation.</p>
Green	
FY12	
Green	

PERFORMANCE REPORTING AND PLANNING

Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
ES-12-1: Demonstrate planned progress in understanding and improving predictive capability for changes in the ozone layer, climate forcing, and air quality associated with changes in atmospheric composition. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.					
Contributing Theme:		Earth Science			
Contributing Program(s):		Multiple Programs			
FY07	FY08	FY09	FY10	FY11	FY12
7ESS1 Green	8ES01 Green	9ES1 Green	10ES01 Green	ES-11-1 Green	ES-12-1 Green
Planned Annual Performance					
FY13 Update	ES-13-1: Demonstrate planned progress in understanding and improving predictive capability for changes in the ozone layer, climate forcing, and air quality associated with changes in atmospheric composition. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.				
FY14	ES-14-1: Demonstrate planned progress in understanding and improving predictive capability for changes in the ozone layer, climate forcing, and air quality associated with changes in atmospheric composition. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.				

Reported Multi-Year Performance

Multi-Year Performance Goal 2.1.1.2: By 2015, launch at least two missions in support of objective 2.1.1.

FY11	The purpose of this performance goal is to launch satellites in support of objective 2.1.1, as outlined in the NASA Science Mission Directorate's 2010 Science Plan . NASA's Earth Science program includes the design, development, and launch of a portfolio of new missions, along with the operation and provision of data from the existing fleet of Earth observing spacecraft. Launching missions in a timely way increases scientific capabilities and helps maintain data continuity. Once the satellites are operating on orbit, NASA uses these assets for scientific research and a range of Earth-observing capabilities. Earth Science launched the first satellite supporting this performance goal, Aquarius , in June 2011. Aquarius will observe and model seasonal and year-to-year variations of sea-surface salinity and how these variations relate to changes in the water cycle and ocean circulation, thereby influencing climate. During its three-year mission life, Aquarius will collect more sea surface salinity measurements than the entire 125-year historical record from ships and buoys.
Green	
FY12	The next mission, Orbiting Carbon Observatory (OCO)-2 , is planned for launch no earlier than 2014, but within the completion timeframe for the performance goal. NASA completed the OCO-2 Systems Integration Review on May 2, 2012, certifying that OCO-2's systems were working together and could be integrated into the spacecraft bus for testing. OCO-2
Green	

PERFORMANCE REPORTING AND PLANNING

	will be NASA's first dedicated Earth remote sensing satellite to study atmospheric carbon dioxide from space.
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Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
ES-12-2: Complete the Orbiting Carbon Observatory-2 (OCO-2) Systems Integration Review.					
Contributing Theme:		Earth Science			
Contributing Program(s):		Earth System Science Pathfinder			
FY07	FY08	FY09	FY10	FY11	FY12
7ESS6 Yellow	8ES04 Yellow	9ES2 Green	10ES22 Green	ES-11-3 Yellow	ES-12-2 Green
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	ES-14-2: Complete the Orbiting Carbon Observatory-2 (OCO-2) observatory testing.				
Comments	NASA did not assign a measure to OCO-2 in FY 2013 due to the schedule uncertainty associated with the project's launch vehicle. Following the failure of the Glory mission's Taurus X/L launch vehicle, NASA revised the plan to launch OCO-2 on this same vehicle. A delay in the project was required to allow the procurement of a new launch vehicle. The project is now on track for a 2014 launch.				

Reported Annual Performance					
ES-12-3: Complete the Earth Venture-1 (EV-1) Investigation Readiness Reviews (IRR) and begin initial field campaigns.					
Contributing Theme:		Earth Science			
Contributing Program(s):		Earth System Science Pathfinder			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	ES-11-4 Green	ES-12-3 Green
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	No annual performance goal in FY14.				

PERFORMANCE REPORTING AND PLANNING

Reported Multi-Year Performance

Multi-Year Performance Goal 2.1.2.1: Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base. (In support of objective 2.1.2: "Enable improved predictive capability for weather and extreme weather events.")

FY11	<p>NASA sponsored research continued to gain new insight into weather and extreme-weather events by the use of data obtained from a variety of satellite platforms. Several studies have examined the robust signatures of internal gravity waves in Atmospheric Infrared Sounder Instrument (AIRS) data. AIRS has been used not only to understand the physics of gravity waves and its interactions with the large scale weather, but also to develop and improve more sophisticated gravity wave parameterizations for weather and climate prediction models.</p> <p>AIRS is increasingly being used to obtain a deeper understanding of the physics of the atmospheric boundary layer. It was shown that AIRS is capable of producing a realistic structure of temperature and water vapor in the boundary layer over the subtropical oceanic regions covered with shallow cumulus. AIRS also has been shown to be a useful tool for understanding the interactions between the key cloudy boundary layer characteristics and the climatological large scale circulation. This is absolutely essential to understand cloud-climate feedbacks, which are considered by the Intergovernmental Panel on Climate Change (IPCC) to be the main reason for uncertainty in current climate change projections.</p> <p>NASA's Short-term Prediction Research and Transition (SPoRT) Center continues to transition experimental satellite data and forecast products to NOAA's National Weather Service (NWS) forecast offices and NOAA/NWS/National Centers for Environmental Prediction, to advance current techniques for weather analysis and forecasting while also preparing forecasters for the next generation of geostationary and polar-orbiting satellite capabilities. NASA collaborates with the NOAA Geostationary Operational Environmental Satellite (GOES)-R and Joint Polar Satellite System (JPSS) Proving Grounds to demonstrate future forecasting capabilities by using Moderate Resolution Imaging Spectroradiometer (MODIS) data from Terra and Aqua, and more recently, the Visible Infrared Imaging Radiometer Suite (VIIRS) instrument launched aboard the Suomi National Polar Orbiting Partnership (NPP) in October 2011. Furthermore, SPoRT's collaborations with NOAA have integrated NASA observations into the next generation decision support system AWIPS II used by NWS forecasters in analysis and emergency response applications.</p> <p>Using 12 years of Tropical Rainfall Measurement Mission (TRMM) rainfall data, NASA scientists find that a warmer tropical ocean favors a large increase in occurrence of extreme heavy rain events in a warmer climate (near doubling for every degree increase in tropical sea surface temperature). The increase is coupled to a modest reduction in light to moderate rain, and a slight increase in very light rain over the tropic. This shift in tropical rainfall distribution is similar to that found in previous studies for multi-decadal rainfall trend. The paper demonstrates that TRMM data, when used appropriately, can shed new light on how the tropical rainfall systems may respond in a warmer climate.</p> <p>Tropical cyclone are a form of extreme weather event with highly destructive power. Using TRMM and Global Precipitation Climatology project rainfall data, NASA scientists find that storms are becoming more energetic (wetter) in the North Atlantic, but less energetic (drier) in the North Pacific in the last two decades. These shifts are consistent with long-term changes in sea surface temperature and wind shear over the two ocean basins. This work also provides an alternative to the conventional way of classifying tropical cyclones based on instantaneous winds (i.e., the Saffir-Simpson scale) using rainfall in terms of latent</p>
Green	
FY12	
Green	

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	energy per storm (EPS). The EPS classification has the advantage of being universal for all ocean basins, not subject to sampling errors involved in measurement of instantaneous winds. As the length of the satellite rainfall dataset increases, the EPS classification will become more important.
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Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
ES-12-4: Demonstrate planned progress in enabling improved predictive capability for weather and extreme weather events. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.					
Contributing Theme:		Earth Science			
Contributing Program(s):		Multiple Programs			
FY07	FY08	FY09	FY10	FY11	FY12
7ESS2	8ES02	9ES7	10ES04	ES-11-5	ES-12-4
Green	Green	Green	Green	Green	Green
Planned Annual Performance					
FY13 Update	ES-13-3: Demonstrate planned progress in enabling improved predictive capability for weather and extreme weather events. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.				
FY14	ES-14-3: Demonstrate planned progress in enabling improved predictive capability for weather and extreme weather events. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.				

Reported Multi-Year Performance

Multi-Year Performance Goal 2.1.2.2: By 2015, launch at least two missions in support of objective 2.1.2.

FY11	<p>The purpose of this performance goal is to launch satellites in support of objective 2.1.2, as outlined in the NASA Science Mission Directorate's 2010 Science Plan. NASA's Earth Science program includes the design, development, and launch of a portfolio of new missions, along with the operation and provision of data from the existing fleet of Earth observing spacecraft. Launching missions in a timely way increases scientific capabilities and helps maintain data continuity. Once the satellites are operating on orbit, NASA uses these assets for scientific research and a range of Earth observing capabilities.</p> <p>NASA launched the first mission satisfying this performance goal, the NPOESS Preparatory Project (NPP), in October 2011. Once the satellite was on orbit and checked out, NASA renamed the mission Suomi National Polar-orbiting Partnership, in honor of the late Verner E. Suomi, a meteorologist at the University of Wisconsin who is recognized widely as "the father of satellite meteorology." Suomi NPP, a bridge between NASA's Earth Observing System satellites and the next-generation Joint Polar Satellite System, is collecting critical data to improve short-term weather forecasts and increase understanding of long-term climate change.</p>
Green	
FY12	
Green	

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	<p>The second mission, Global Precipitation Measurement (GPM), is planned for launch in February 2014, within the performance goal timeframe. NASA anticipated completing the Pre-Environmental Review (PER) in FY 2012, but a preceding review, the Comprehensive Performance Test, was delayed from September to October 2012 due to various integration and test issues. NASA successfully completed the PER on October 23, 2012. The GPM mission will advance the measurement of global precipitation, making possible high spatial resolution precipitation measurements. A joint mission with the Japanese Aerospace Exploration Agency (JAXA), GPM will provide the first opportunity to calibrate measurements of global precipitation (including the distribution, amount, rate, and associated heat released) across tropical, mid-latitude, and polar regions.</p>
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Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
No annual performance goal in FY12 or trended performance.					
Contributing Theme:		Earth Science			
Contributing Program(s):		Earth System Science Pathfinder			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	None	None
Planned Annual Performance					
FY13 Update	ES-13-2: Complete the Earth Venture-2 (EV-2) Mission Definition Review (MDR).				
FY14	ES-14-5: Complete Cyclone Global Navigation Satellite System (CYGNSS/EV-2) Preliminary Design Review.				

Reported Annual Performance					
ES-12-5: Complete the Global Precipitation Measurement (GPM) Pre-Environmental Review.					
Contributing Theme:		Earth Science			
Contributing Program(s):		Earth Systematic Missions			
FY07	FY08	FY09	FY10	FY11	FY12
None	8ES06 Yellow	9ES8 Yellow	10ES06 Green	ES-11-6 Yellow	ES-12-5 Yellow

Why this APG was not achieved:					
<p>The GPM Pre-Environmental Review (PER) was delayed from September to October 2012 due to multiple integration and test issues. NASA allowed the extra time so the project could investigate High Gain Antenna System mechanical interference and GPM Microwave Imager (GMI) Radio Frequency interference. The delay also allowed the project to closeout several subsystem test Problem Reports and complete installation of the remaining Thermal Control System components. All of these activities were necessary prior to NASA conducting the Comprehensive Performance Test, which is required prior to conducting the PER.</p> <p>Throughout the GPM project, NASA has had to adjust the schedules as a result of challenges in component deliveries, delivery of the partner-provided instruments, and system integration and test, which are often encountered during the development of space flight hardware. However, subsequent to a replan, the project has maintained its budget and launch date commitments, despite additional delays to interim milestones.</p>					

PERFORMANCE REPORTING AND PLANNING

Planned Annual Performance	
FY13 Update	ES-13-4: Complete the Global Precipitation Measurement (GPM) mission observatory environmental testing.
FY14	ES-14-4: Launch the Global Precipitation Measurement (GPM) mission.

Reported Multi-Year Performance

Multi-Year Performance Goal 2.1.3.1: Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base. (In support of objective 2.1.3: "Quantify, understand, and predict changes in Earth's ecosystems and biogeochemical cycles, including the global carbon cycle, land cover, and biodiversity.")

FY11	<p>The discovery of massive phytoplankton (free-floating single-celled photosynthetic organisms at the base of the marine food web) blooms under Arctic sea ice is a major advance in understanding that resulted directly from the Impacts of Climate change on the Eco-Systems and Chemistry of the Arctic Pacific Environment (ICESCAPE) Program. Prior to this field program, estimates of pan-Arctic primary productivity assumed that the growth and biomass of phytoplankton were negligible in waters beneath ice because of insufficient light. However, the 2011 ICESCAPE cruise observed a bloom beneath the 0.8- to 1.3-meter-thick first-year sea ice on the Chukchi Sea continental shelf. The finding reveals a new consequence of the Arctic's warming climate and provides an important clue to understanding the impacts of a changing climate and environment on the Arctic Ocean and its ecology.</p> <p>The dynamics of Arctic and sub-Arctic vegetation was the topic of several individual research papers and a special issue of Environmental Research Letters published in late 2011. Arctic vegetation has been changing in response to changes in climate, and these changes are widespread through the circumpolar North. Understanding the details of these vegetation dynamics spatially and temporally, as well as the mechanisms of change, is crucial to projecting the future of this extensive, heterogeneous, and important biome. While the Arctic tundra has shown indications of ubiquitous increases in vegetation ("greening"), there are clearly areas that are not greening, and the boreal forest appears to be changing in many places in the opposite direction (i.e., "browning").</p> <p>In 2012, the first remote sensing-based products from Carbon Monitoring System (CMS) pilot studies were released for review and further quality assessment. The biomass pilot study's products included a U.S. forest biomass map, state biomass maps for California and Maryland, and local biomass maps for four sites in the eastern United States. The flux pilot study's products included modeled carbon dioxide exchanges between terrestrial ecosystems and the atmosphere, and between the ocean and the atmosphere. The pilot products will guide the development of the CMS, which will estimate carbon budgets and monitor carbon sources and sinks.</p> <p>The first results from analysis of NASA's remote sensing data collected over the 2010 Deepwater Horizon oil spill were published during the past year. An overview paper reported that spill and impact monitoring was aided by extensive airborne and spaceborne passive and active remote sensing. Oil slick thickness and oil-to-water emulsion ratios, key spill response parameters for containment or cleanup, were derived quantitatively for thick (more than 0.1 millimeter) slicks from NASA's Airborne Visible/Infrared Imaging Spectrometer (AVIRIS) data. MODIS observations were used to extrapolate the AVIRIS-based estimates to the total slick. MODIS data proved to be critical for oil spill response</p>
Green	
FY12	
Green	

PERFORMANCE REPORTING AND PLANNING

	<p>decision making due to their frequent temporal coverage, broad spatial coverage, and timely availability. The significantly greater signal-to-noise ratio and finer spatial resolution of the NASA Uninhabited Aerial Vehicle Synthetic Aperture Radar (UAVSAR) allowed successful pattern discrimination of oil slick characteristics and was useful in identifying shoreline marsh damage. In situ burning and smoke plumes were studied with AVIRIS and corroborated with spaceborne Cloud Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO) observations of combustion aerosols. NASA researchers were also able to address concerns about the impacts of the oil spill on the western stock of the Atlantic bluefin tuna. Initial results showed that on a weekly basis, up to five percent of spawning habitat was likely to have been affected by surface oil, with up to 11 percent potentially affected by oil-contaminated waters.</p>
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Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
ES-12-6: Demonstrate planned progress in quantifying, understanding, and predicting changes in Earth's ecosystems and biogeochemical cycles, including the global carbon cycle, land cover, and biodiversity. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.					
Contributing Theme:			Earth Science		
Contributing Program(s):			Multiple Programs		
FY07	FY08	FY09	FY10	FY11	FY12
7ESS3 Green	8ES03 Green	9ES10 Green	10ES07 Green	ES-11-7 Green	ES-12-6 Green

Planned Annual Performance	
FY13 Update	ES-13-5: Demonstrate planned progress in quantifying, understanding and predicting changes in Earth's ecosystems and biogeochemical cycles, including the global carbon cycle, land cover, and biodiversity. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.
FY14	ES-14-6: Demonstrate planned progress in quantifying, understanding and predicting changes in Earth's ecosystems and biogeochemical cycles, including the global carbon cycle, land cover, and biodiversity. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.

Reported Multi-Year Performance

Multi-Year Performance Goal 2.1.3.2: By 2015, launch at least two missions in support of objective 2.1.3.

FY11	<p>The purpose of this performance goal is to launch satellites in support of objective 2.1.3, as outlined in the NASA Science Mission Directorate's 2010 Science Plan. NASA's Earth Science program includes the design, development, and launch of a portfolio of new missions, along with the operation and provision of data from the existing fleet of Earth observing spacecraft. Launching missions in a timely way increases scientific capabilities and helps maintain data continuity. Once the satellites are operating on orbit, NASA uses these assets for scientific research and a range of Earth observing capabilities.</p>
Green	
FY12	
Green	

PERFORMANCE REPORTING AND PLANNING

	<p>The first mission, the Landsat Data Continuity Mission (LDCM), is planned for launch in 2013. NASA completed the Systems Integration Review on September 9, 2011, giving the project the go-ahead to integrate the systems into the spacecraft bus for testing. LDCM will extend the record of multispectral, moderate resolution Landsat-quality data and will meet government operational and scientific requirements for observing land use and land change. New changes in land cover and use are having profound consequences for weather and climate change, ecosystem function and services, carbon cycling and sequestration, resource management, the national and global economy, human health, and society.</p> <p>The second mission, OCO-2, is planned for launch no earlier than 2014, but within the completion timeframe for the performance goal.</p>
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Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
ES-12-2: Complete the Orbiting Carbon Observatory-2 (OCO-2) Systems Integration Review.					
Contributing Theme:		Earth Science			
Contributing Program(s):		Earth System Science Pathfinder			
FY07	FY08	FY09	FY10	FY11	FY12
7ESS6 Yellow	8ES04 Yellow	9ES2 Green	10ES22 Green	ES-11-3 Yellow	ES-12-2 Green
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	ES-14-2: Complete the Orbiting Carbon Observatory-2 (OCO-2) observatory testing.				
Comments	NASA did not assign a measure to OCO-2 in FY 2013 due to the schedule uncertainty associated with the project's launch vehicle. Following the failure of the Glory mission's Taurus X/L launch vehicle, NASA revised the plan to launch OCO-2 on this same vehicle. A delay in the project was required to allow the procurement of a new launch vehicle. The project is now on track for a 2014 launch.				

Reported Annual Performance					
ES-12-3: Complete the Earth Venture-1 (EV-1) Investigation Readiness Reviews (IRR) and begin initial field campaigns.					
Contributing Theme:		Earth Science			
Contributing Program(s):		Earth System Science Pathfinder			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	ES-11-4 Green	ES-12-3 Green
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	No annual performance goal in FY14.				

PERFORMANCE REPORTING AND PLANNING

Reported Annual Performance					
ES-12-7: Complete the Landsat Data Continuity Mission (LDCM) Systems Integration Review.					
Contributing Theme:		Earth Science			
Contributing Program(s):		Earth Systematic Missions			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	9ES11 Yellow	10ES08 Green	ES-11-8 Green	ES-12-7 Green
Planned Annual Performance					
FY13 Update	ES-13-6: Launch the Landsat Data Continuity Mission (LDCM).				
FY14	No annual performance goal in FY14.				

Reported Multi-Year Performance

Multi-Year Performance Goal 2.1.4.1: Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base. (In support of objective 2.1.4: "Quantify the key reservoirs and fluxes in the global water cycle and assess water cycle change and water quality.")

FY11	<p>Over the past year, NASA has continued progress toward improving description of the water cycle, including the size of and movement between, the water cycle's stores. Two newly provided variables from space, groundwater, and total storage, have been enabled from Gravity Recovery and Climate Experiment (GRACE) observations of the changing geoid of the Earth, which, at monthly time scales, is strongly coupled with the movement of water.</p> <p>GRACE data's contribution of large area assessment of water movement has been transformed via data assimilation into Land Surface Models (LSMs), which are responsible for tracking the vertical movement of water and energy between the atmosphere and land, as well as contribution to river runoff. This coupling of capabilities led to improvement in data for 17 out of 18 global river basins, some of which are at finer spatial scales than the GRACE observation footprint (for total water storage). This coupling has also led to improved assessment of changes in groundwater stores in the United States. This information has been blended easily into the work of the National Drought Mitigation Center as some of their data inputs also come via LSMs. Overall, these developments have been helpful during a period of increasing spread and severity of drought in the United States, especially since there has been no accompanying increase in ground-based measures of root-zone soil moisture or groundwater.</p> <p>When looking at climate projections, it is important to assess the sensitivity of the system components to climate extremes and to understand the impact that these extremes might have. River basins provide the natural boundaries over which to index water resources renewal relevant to most human and natural systems. NASA investigators studied 194 major river basins across the globe, as captured with models, to determine their sensitivity to global mean temperature, as a proxy for other potential changes. Results show that the runoff sensitivity implied by the IPCC experiments is relatively stable across emission scenarios and global mean temperature increments, but varies substantially across models with the exception of the high-latitudes and currently arid or semi-arid areas.</p>
FY12	

PERFORMANCE REPORTING AND PLANNING

	<p>The unprecedented snowfall in the Baltimore–Washington region and greater East coast during the 2009–2010 winter unveiled important aspects of water cycle dynamics and the value of snowpack remote sensing. Specifically, concerted effort was made to link the remotely sensed falling snow observations to remotely sensed snow cover and snow pack observations during those storms. Detailed study revealed the strong influence of the Arctic Oscillation, a see-sawing pressure difference between the Arctic and lower latitudes, on creating conditions favorable for record snowfall and showing the impacts of snow intensity and liquid water clouds on the ability to detect snow water equivalent and other snowpack properties as they evolve in time.</p> <p>Multiple NASA endeavors continue to pursue generation and refinement of long-term records of water cycle variables. Researchers used long-term records of precipitation found in the climate prediction CPC [Climate Prediction Center] Merged Analysis of Precipitation (CMAP) and the Global Precipitation Climatology Project (GPCP) to investigate the climate system at decadal scales. The decadal variability in the Northern hemisphere cool season (October through March) Arctic precipitation was detected in both aforementioned precipitation data sets. Furthermore, this variability is shown to be partly connected to the variations in the tropical central Pacific sea surface temperatures that are primarily associated with the El Niño–Southern Oscillation (ENSO), or transitions between periods favoring typical eastern Pacific warming events and periods favoring central Pacific warming events.</p>
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Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
ES-12-8: Demonstrate planned progress in quantifying the key reservoirs and fluxes in the global water cycle and assessing water cycle change and water quality. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.					
Contributing Theme:		Earth Science			
Contributing Program(s):		Multiple Programs			
FY07	FY08	FY09	FY10	FY11	FY12
7ESS5 Green	8ES05 Green	9ES13 Green	10ES09 Green	ES-11-9 Green	ES-12-8 Green
Planned Annual Performance					
FY13 Update	ES-13-7: Demonstrate planned progress in quantifying the key reservoirs and fluxes in the global water cycle and assessing water cycle change and water quality. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.				
FY14	ES-14-7: Demonstrate planned progress in quantifying the key reservoirs and fluxes in the global water cycle and assessing water cycle change and water quality. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.				

PERFORMANCE REPORTING AND PLANNING

Reported Multi-Year Performance

Multi-Year Performance Goal 2.1.4.2: By 2015, launch at least two missions in support of objective 2.1.4.

FY11	<p>The purpose of this performance goal is to launch satellites in support of objective 2.1.4, as outlined in the NASA Science Mission Directorate's 2010 Science Plan. NASA's Earth Science program includes the design, development, and launch of a portfolio of new missions, along with the operation and provision of data from the existing fleet of Earth observing spacecraft. Launching missions in a timely way increases scientific capabilities and helps maintain data continuity. Once the satellites are operating on orbit, NASA uses these assets for scientific research and a range of Earth observing capabilities. NASA launched Aquarius in June 2011 and plans to launch GPM in February 2014.</p> <p>NASA also is developing another mission, Soil Moisture Active Passive (SMAP), for launch in late 2014, that would serve this performance goal. NASA completed the SMAP Critical Design Review on July 19, 2012, enabling the project to begin final design and fabrication. The accuracy, resolution, and global coverage of SMAP soil moisture and freeze/thaw measurements will be unprecedented. The SMAP data, when assimilated into existing and updated Earth system science models, will lead to improved weather forecasts, flood and drought forecasts, and predictions of agricultural productivity and climate change, as well as improved understanding of the sources and sinks of carbon.</p>
Green	
FY12	
Green	

Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
ES-12-5: Complete the Global Precipitation Measurement (GPM) Pre-Environmental Review.					
Contributing Theme:		Earth Science			
Contributing Program(s):		Earth Systematic Missions			
FY07	FY08	FY09	FY10	FY11	FY12
None	8ES06 Yellow	9ES8 Yellow	10ES06 Green	ES-11-6 Yellow	ES-12-5 Yellow
Why this APG was not achieved:					
<p>The GPM Pre-Environmental Review (PER) was delayed from September to October 2012 due to multiple integration and test issues. NASA allowed the extra time so the project could investigate High Gain Antenna System mechanical interference and GPM Microwave Imager (GMI) Radio Frequency interference. The delay also allowed the project to closeout several subsystem test Problem Reports and complete installation of the remaining Thermal Control System components. All of these activities were necessary prior to NASA conducting the Comprehensive Performance Test, which is required prior to conducting the PER.</p> <p>Throughout the GPM project, NASA has had to adjust the schedules as a result of challenges in component deliveries, delivery of the partner-provided instruments, and system integration and test, which are often encountered during the development of space flight hardware. However, subsequent to a replan, the project has maintained its budget and launch date commitments, despite additional delays to interim milestones.</p>					

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Planned Annual Performance	
FY13 Update	ES-13-4: Complete the Global Precipitation Measurement (GPM) mission observatory environmental testing.
FY14	ES-14-4: Launch the Global Precipitation Measurement (GPM) mission.

Reported Annual Performance					
ES-12-9: Successfully complete the Soil Moisture Active-Passive (SMAP) Critical Design Review.					
Contributing Theme:		Earth Science			
Contributing Program(s):		Earth Systematic Missions			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	9ES14 Green	10ES10 Yellow	ES-11-10 Yellow	ES-12-9 Green
Planned Annual Performance					
FY13 Update	ES-13-8: Complete the Soil Moisture Active Passive (SMAP) Systems Integration Review (SIR).				
FY14	ES-14-8: Complete Soil Moisture Active Passive (SMAP) Instrument Thermal Vacuum Test.				

Reported Multi-Year Performance

Multi-Year Performance Goal 2.1.5.1: Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base. (In support of objective 2.1.5: "Improve understanding of the roles of the ocean, atmosphere, land and ice in the climate system and improve predictive capability for its future evolution.")

FY11 Green	<p>Studies of sea level rise between 1961 and 2008, performed with a combination of radar altimetry, tide gage and other data, reveal a rate of +2.1 millimeter per year (+3.4 millimeter per year from 1993 through 2008). ENSO, which is associated with precipitation falling over the continents rather than the oceans, caused a two-year dip in the curve beginning in 2011. Over the past year, the first results from the Aquarius/SAC-D mission, launched in June 2011, began appearing in the scientific literature. Its global sea-surface salinity data provided the first observation of the salinity structure and propagation properties of tropical instability waves in the equatorial Pacific.</p> <p>Satellite data during the past year continued to show a decline in Arctic sea ice cover, both in extent and thickness. The Arctic sea-ice extent dropped to 3.41 million square kilometers, which is well below the previous record of 4.17 million square kilometers observed in 2007. Also, the drastic reduction of older perennial sea ice in the Arctic Ocean has resulted in a substantial increase of younger and saltier sea ice with the subsequent release of bromine monoxide and the reduction of atmospheric ozone and mercury. The thinning Arctic ice also appears to allow sunlight to reach the underlying water, catalyzing previously unobserved phytoplankton blooms; this yielded blooms with growth rates up to 10 times higher than those in adjacent open water.</p> <p>A large-scale survey of snow depth on sea ice was conducted using laser altimeter and ultra-wideband microwave radar data collected by Operation IceBridge. The results were consistent with historical climatology over multi-year ice, but showed larger differences over first-year ice, suggesting that the increasingly seasonal sea ice cover of the Arctic Ocean has led to an overall loss of snow. Researchers also used the collected snow depths to derive sea ice thicknesses, and both measurements were compared to in situ data, with mean</p>
FY12 Green	

PERFORMANCE REPORTING AND PLANNING

	<p>differences of one centimeter for the former and five centimeters for the latter. In addition, satellite radar data, collected through a broad international collaboration with other space agencies, were processed to provide comprehensive views of glacier velocities in both Greenland and Antarctica. Decade-long time series were generated for nearly all of Greenland's outlet glaciers, revealing complex, inter-regional, and intra-regional variability and suggesting that the ice sheet's contribution to sea-level rise may be on the lower end of current predictions. In Antarctica, researchers found that ice flow is driven by a complex set of meandering, size-varying, speed varying, intertwined tributaries. This discovery challenged the traditional view that ice flow is constrained by internal deformation and disconnected from coastal regions. Furthermore, similar radar data, collected over the ice shelves that extend from Antarctica into the ocean, were used to establish a 30-year time series of elevation change. This will further efforts to understand the relative roles of surface mass balance and subsurface melting in driving the future evolution of both the ice shelves and the glaciers that feed them.</p> <p>Several modeling activities have contributed to better understanding the climate system and improving predictive capabilities. The Ice-Sheet System Model, a major new ice-sheet model that was recently completed and released, provides a high-resolution, physically based representation of the cryosphere for climate studies. Researchers completed a model of sub ice-shelf circulation and used it to demonstrate the importance of Pine Island ice-shelf melt rates to ocean circulation under the shelf. Modeling of atmospheric processes was pushed to a very high resolution on a global scale, which resulted in a global model with sufficient resolution to resolve cloud systems at the 3.5-kilometer scale.</p>
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Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
ES-12-10: Demonstrate planned progress in understanding the roles of ocean, atmosphere, land, and ice in the climate system and improving predictive capability for future evolution. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.					
Contributing Theme:		Earth Science			
Contributing Program(s):		Multiple Programs			
FY07	FY08	FY09	FY10	FY11	FY12
7ESS7 Green	8ES07 Green	9ES15 Green	10ES11 Green	ES-11-11 Green	ES-12-10 Green
Planned Annual Performance					
FY13 Update	ES-13-9: Demonstrate planned progress in understanding the roles of ocean, atmosphere, land, and ice in the climate system and improving predictive capability for future evolution. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.				
FY14	ES-14-9: Demonstrate planned progress in understanding the roles of ocean, atmosphere, land, and ice in the climate system and improving predictive capability for future evolution. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.				

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Reported Annual Performance					
ES-12-11: Achieve mission success criteria for the Ocean Surface Topography Mission (OSTM).					
Contributing Theme:		Earth Science			
Contributing Program(s):		Earth Systematic Missions			
FY07	FY08	FY09	FY10	FY11	FY12
7ESS9 Green	8ES08 Green	None	None	None	ES-12-11 Green
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	No annual performance goal in FY14.				

Reported Multi-Year Performance

Multi-Year Performance Goal 2.1.5.2: HPPG: Study Earth from space to understand climate change, weather, and human impact on our planet by launching at least two missions by 2015.

FY11	To achieve this goal, NASA planned to launch and successfully place in orbit two satellites: Glory and NPP . NASA launched NPP on October 28, 2011, and shortly after it began operations, renamed it Suomi NPP. Despite this success, NASA was unable to achieve this performance goal because Glory was lost during launch on March 4, 2011, due to the failure of the Taurus XL launch vehicle.
Red	
FY12	Suomi NPP has orbited the Earth more than 5,000 times and begun returning images and data that provide critical weather and climate measurements of the complex Earth system. The data captured from Suomi NPP monitored this year's Antarctic Ozone Hole and is improving daily weather forecasts. Suomi NPP data is being connected to EOS data to help to monitor long-term environmental change.
Red	
	NASA has redirected the efforts of the Glory science team to use data from the Research Scanning Polarimeter (RSP) , a version of the Glory Aerosol Polarimetry Sensor (APS) instrument, which was designed to be flown on an aircraft. RPS will allow the team to pursue some of the aerosol climate science that APS was meant to address. The team will use data from future flights of the RPS, as well as data that was previously collected and archived, to study some of the processes by which aerosols influence atmospheric conditions.
	In the absence of the Glory Total Irradiance Monitor (TIM) instrument, NASA continues to provide measurements of total solar irradiance measurements from two spacecraft that are in extended missions. These are the Active Cavity Radiometer Irradiance Monitor (AcrimSat) , which was launched in 1999, and the Solar Radiation and Climate Experiment (SORCE) mission, which was launched in 2003. NOAA is considering options for launching the next instrument, called the Total Solar Irradiance Sensor (TSIS) , which will continue this long-term record.

Update to Multi-Year Performance Goal	
FY13 Update	No performance goal in FY13.
FY14	No performance goal in FY14.

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Comments	This was one of NASA's original Priority Goals created in FY 2010. NASA reviewed the goal and associated milestones with the Office of Management and Budget (OMB) during FY 2012 and, with the OMB's approval, has closed out this Priority Goal.
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Reported Annual Performance					
ES-12-12: Launch the National Polar-orbiting Operational Environmental Satellite System (NPOESS) Preparatory Project (NPP).					
Contributing Theme:		Earth Science			
Contributing Program(s):		Earth Systematic Missions			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	ES-11-12 Green	ES-12-12 Green
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	No annual performance goal in FY14.				

Reported Multi-Year Performance

Multi-Year Performance Goal 2.1.5.3: By 2015, launch at least three missions in support of objective 2.1.5.

FY11	<p>The purpose of this performance goal is to design, develop, and launch satellites in support of objective 2.1.5, as outlined in the NASA Science Mission Directorate's 2010 Science Plan. NASA's Earth Science program includes the design, development, and launch of a portfolio of new missions, along with the operation and provision of data from the existing fleet of Earth observing spacecraft. Launching missions in a timely way increases scientific capabilities and helps maintain data continuity. Once the satellites are operating on orbit, NASA uses these assets for scientific research and a range of Earth observing capabilities. NASA launched Aquarius in June 2011 and NPP in October 2011, placing the Agency on track to complete the performance goal. The third mission, OCO-2, is planned for launch no earlier than 2014, but within the completion timeframe for the goal.</p> <p>NASA also has been working on the Ice, Cloud, and Land Elevation Satellite (ICESat)-2, which will study ice-sheet thickness and changes. The project is nearing the end of its formulation phase, and individual instruments are already in development.</p>
Green	
FY12	
Green	

Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

PERFORMANCE REPORTING AND PLANNING

Reported Annual Performance					
ES-12-2: Complete the Orbiting Carbon Observatory-2 (OCO-2) Systems Integration Review.					
Contributing Theme:		Earth Science			
Contributing Program(s):		Earth System Science Pathfinder			
FY07	FY08	FY09	FY10	FY11	FY12
7ESS6 Yellow	8ES04 Yellow	9ES2 Green	10ES22 Green	ES-11-3 Yellow	ES-12-2 Green
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	ES-14-2: Complete the Orbiting Carbon Observatory-2 (OCO-2) observatory testing.				
Comments	NASA did not assign a measure to OCO-2 in FY 2013 due to the schedule uncertainty associated with the project's launch vehicle. Following the failure of the Glory mission's Taurus X/L launch vehicle, NASA revised the plan to launch OCO-2 on this same vehicle. A delay in the project was required to allow the procurement of a new launch vehicle. The project is now on track for a 2014 launch.				

Reported Annual Performance					
ES-12-13: Complete the Ice, Cloud, and Land Elevation Satellite-2 (ICESat-2) Preliminary Design Review.					
Contributing Theme:		Earth Science			
Contributing Program(s):		Earth Systematic Missions			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	9ES16 Yellow	10ES12 Green	ES-11-14 Yellow	ES-12-13 Yellow
Why this APG was not achieved:					
<p>NASA delayed the date for the ICESat-2 Preliminary Design Review from July 2012 to October 2012 so the project could revisit the mission design and requirements in order to align with the estimated available budget, moving forward in fiscal years 2014 and 2015.</p> <p>The ICESat-2 project has received three Yellow ratings during the four years it has been in performance review. The project has received all of these during its formulation phase. The first Yellow rating occurred early in the project's formulation, when the Earth Systematic Missions Program was conducting the advanced concepts study. The other two Yellows have been the result of NASA's difficulty in acquiring a launch vehicle. This challenge has resulted in changes to the project budget and schedule delays. NASA remains dedicated to the ICESat-2 project because the spacecraft will be an integral part of NASA's Earth-observation fleet of satellites. It will provide estimates of ice sheet thickness and help scientists determine ice sheet contributions to recent sea level change. The first mission, ICESat, successfully completed operations in 2009, and NASA has been conducting observations from aircraft, through the IceBridge project, in the interim between ICESat missions.</p>					
Planned Annual Performance					
FY13 Update	ES-13-10: Complete the Ice, Cloud, and Land Elevation Satellite-2 (ICESat-2) Critical Design Review.				
FY14	ES-14-10: Deliver the Ice, Cloud, and Land Elevation Satellite-2 (ICESat-2) flight lasers.				

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Reported Multi-Year Performance

Multi-Year Performance Goal 2.1.6.1: Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base. (In support of objective 2.1.6: "Characterize the dynamics of Earth's surface and interior and form the scientific basis for the assessment and mitigation of natural hazards and response to rare and extreme events.")

FY11	<p>NASA's Earth Surface and Interior focus area has prioritized strengthening of the global geodetic network infrastructure in response to the recommendations of National Research Council's report Precise Geodetic Infrastructure: National Requirements for a Shared Resource (2010). Space-geodetic observations provide the basis for the reference frame that is needed in order to assign coordinates to points and objects and thereby determine how those points and objects move over time. NASA's Space Geodesy Project (SGP) initiated development of the prototype core geodetic observatory to replace an aging global network. The prototype geodetic observatory will be completed by August 2013, while work will continue on the development of analysis software. Progress to date includes the day and night tracking of the Global Navigation and Satellite Systems (GNSS) satellites by the automated Satellite Laser Ranging instrument.</p> <p>NASA achieved significant success in demonstrating the capability and potential of real time GNSS ground networks in 2012, in particular the Great Alert program for the real time estimation of earthquake fault motions and tsunami prediction. NASA-funded grants advanced the calculation of real time fault motions such as the demonstration that if the Japanese GEONET GPS data were available in real time, an accurate estimate of the magnitude of the March 2011 Japan earthquake would have been available within two minutes of the rupture, nearly 12 minutes prior to the first inundation of the tsunami and about 18 minutes prior to the fastest available seismic techniques. Furthermore, these real time data could have provided both predictions and observations of the devastating Tohoku tsunamis using GPS-based crustal motion estimates followed by confirmation and tracking via the induced ionospheric gravity waves. NASA, the National Science Foundation, and several universities have joined in support of the Real-time Earthquake Analysis for Disaster Mitigation (READI) Network of about 500 GNSS receivers in the U.S. West.</p> <p>Last year NASA-funded researchers identified ultra-low-frequency signals of Earth's magnetic field associated with surface stress changes and earthquakes. They led an earthquake probability analysis that utilizes seismicity patterns, which was evaluated as a top performer in the Regional Earthquake Likelihood Models (RELM) analysis conducted by the Southern California Earthquake Center. Finally, QuakeSim, a software development effort, has been awarded NASA's Software of the Year Award for 2012. QuakeSim includes software such as Virtual California, a model of the California fault system, and GeoFest, a finite element stress-strain modeling routine.</p> <p>The UAVSAR 2011 through 2012 deployments and objectives included: volcanic deformation studies of Cascades, Aleutian Islands, Hawaii and Central America, deformation associated with plate boundaries in California along the San Andreas, Hayward, and associated faults and fault systems in Hispaniola, surface deformation associated with Gulf Coast subsidence, surface deformation associated with levee conditions in the Sacramento and Mississippi deltas and environmental impacts of the Gulf oil spill. UAVSAR data revealed the unexpected complexity of faulting during the El Mayor-Cucapah earthquake and identified previously unknown faults. UAVSAR demonstrated the utility of a high-resolution, polarimetric, L-band SAR to provide information on oil containment booms both in and out of water that is relevant to disaster response and management, as well as the detection of a levee break in the Sacramento Delta.</p>
Green	
FY12	
Green	

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Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
ES-12-14: Demonstrate planned progress in characterizing the dynamics of Earth's surface and interior and forming the scientific basis for the assessment and mitigation of natural hazards and response to rare and extreme events. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.					
Contributing Theme:		Earth Science			
Contributing Program(s):		Multiple Programs			
FY07	FY08	FY09	FY10	FY11	FY12
7ESS10	8ES11	9ES17	10ES13	ES-11-15	ES-12-14
Green	Green	Green	Green	Green	Green

Planned Annual Performance	
FY13 Update	ES-13-11: Demonstrate planned progress in characterizing the dynamics of Earth's surface and interior and forming the scientific basis for the assessment and mitigation of natural hazards and response to rare and extreme events. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.
FY14	ES-14-11: Demonstrate planned progress in characterizing the dynamics of Earth's surface and interior and forming the scientific basis for the assessment and mitigation of natural hazards and response to rare and extreme events. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.

Reported Multi-Year Performance

Multi-Year Performance Goal 2.1.6.2: By 2015, launch at least one mission in support of objective 2.1.6.

FY11	The purpose of this performance goal is to design, develop, and launch a satellite in support of objective 2.1.6, as outlined in the NASA Science Mission Directorate's 2010 Science Plan . NASA's Earth Science program includes the design, development, and launch of a portfolio of new missions, along with the operation and provision of data from the existing fleet of Earth observing spacecraft. Launching missions in a timely way increases scientific capabilities and helps maintain data continuity. Once the satellite is operating on orbit, NASA uses this asset for scientific research and a range of Earth observing capabilities. In 2013, NASA plans to launch LDCM , which will provide science capabilities in support of this objective.
Green	
FY12	
Green	

Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	No performance goal in FY14.
Comments	The mission supporting objective 2.1.6, LDCM, is scheduled for launch in FY 2013. Once this is completed, NASA will have completed all the milestones for this performance goal. Therefore, NASA is retiring this performance goal in FY 2014.

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Reported Annual Performance					
ES-12-7: Complete the Landsat Data Continuity Mission (LDCM) Systems Integration Review.					
Contributing Theme:		Earth Science			
Contributing Program(s):		Earth Systematic Missions			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	9ES11 Yellow	10ES08 Green	ES-11-8 Green	ES-12-7 Green
Planned Annual Performance					
FY13 Update	ES-13-6: Launch the Landsat Data Continuity Mission (LDCM).				
FY14	No annual performance goal in FY14.				

Reported Multi-Year Performance

Multi-Year Performance Goal 2.1.7.1: Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base. (In support of objective 2.1.7: "Enable the broad use of Earth system science observations and results in decision-making activities for societal benefits.")

FY11	The Applied Sciences Program enables innovative uses of NASA’s Earth science data in organizations’ policy, business, and management decisions to improve quality of life and to help strengthen the economy.
Green	
FY12	Throughout FY 2012, NASA funded awards in four applications areas (Disasters, Ecological Forecasting, Health and Air Quality, and Water Resources), supported interdisciplinary collaboration and enabled organizations to use NASA Earth science data in innovative ways to improve decision-making activities. The program initiated a new phased approach to conducting applications projects—initially supporting a set of feasibility studies and then selecting a subset to pursue as in-depth projects. The program issued 58 new awards under this approach in the areas of Disasters, Water Resources, and Wildland Fires. The joint NASA/ USAID SERVIR Program granted 11 awards to initiate a new SERVIR Applied Sciences Team, broadening the scientific base for the program. SERVIR helps developing countries use Earth observations.
Green	
	The Applied Sciences Program also supported development of the Nation’s scientific capabilities. In an Ecological Forecasting project, NASA teamed with the U.S. Forest Service to apply Landsat , Terra , and Aqua satellite data in carbon assessments across the National Forest System (NFS). An Executive Order and changes to the Code of Federal Regulations mandated increased carbon monitoring for NFS lands. The project team developed the Forest Carbon Management Framework tool providing information about the effects of forest management and natural disturbances on landscape-level carbon storage. In FY 2012, the Forest Service formally included the tool in its carbon assessment approach.
	A Health and Air Quality project applied NASA Earth science data in the production of building climate zone maps. The project collaborated with ASHRAE , the building technology society that produces climate zone maps used by counties and states to set building codes. The project produced maps using outputs from NASA’s Modern-Era Retrospective Analysis For Research And Applications (MERRA) , a long-term synthesis of meteorological variables used for investigating climate variability. Another project in this

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	<p>focus area involved using NASA satellite remote sensing data to extend the coverage of aerosols in the southeastern United States by the CDC Environmental Public Health Tracking Network. This network provides data on environmental factors affecting health to the public, policy makers, and public health professionals.</p> <p>The Natural Disasters applications area works seamlessly with other agencies to aid the government in meeting the challenges associated with natural disaster response and to transfer technologies to other agencies as they become operational. With support from Applied Sciences, NASA contributed to the national response on numerous disasters in 2012, including the provision of satellite data on wildfires, drought, and Hurricanes Isaac and Sandy.</p> <p>The program also manages DEVELOP, a training and development internship program for young professionals. DEVELOP interns gain hands-on experience with satellite remote sensing and apply Earth observations to real-world issues facing state and local governments. The program fosters a corps of early-career professionals, cultivating advanced skills in Earth science applications and an understanding of science in decision-making. DEVELOP set new records during the year, with over 300 interns participating in 64 projects. DEVELOP opened new centers in Missouri and Colorado to expand its national scope.</p>
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Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance						
ES-12-15: Advance at least 25 percent of decision-support projects at least one Applications Readiness Level. The Applications Readiness Level is a nine-stage index for tracking the advancement of an Earth science applications project along a continuum from initial concept through development and transition to operational use.						
Contributing Theme:		Earth Science				
Contributing Program(s):		Applied Sciences				
FY07	FY08	FY09	FY10	FY11	FY12	
7ESS11 Green	8ES12 Green	9ES18 Green	10ES14 Green	ES-11-16 Green	ES-12-15 Green	
Planned Annual Performance						
FY13 Update	ES-13-12: Advance at least 25 percent of decision-support projects one Applications Readiness Level. The Applications Readiness Level is a nine-stage index for tracking the advancement of an Earth science applications project along a continuum from initial concept through development and transition to operational use.					
FY14	ES-14-12: Advance at least 25 percent of decision-support projects one Applications Readiness Level. The Applications Readiness Level is a nine-stage index for tracking the advancement of an Earth science applications project along a continuum from initial concept through development and transition to operational use.					

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Reported Annual Performance					
ES-12-16: Increase the number of science data products delivered to Earth Observing System Data and Information System (EOSDIS) users.					
Contributing Theme:		Earth Science			
Contributing Program(s):		Earth Science Multi-Mission Operations			
FY07	FY08	FY09	FY10	FY11	FY12
None	8ES13 Green	9ES19 Green	10ES15 Green	ES-11-17 Green	ES-12-16 Green
Planned Annual Performance					
FY13 Update	ES-13-13: Increase the number of science data products delivered to Earth Observing System Data and Information System (EOSDIS) users.				
FY14	No annual performance goal in FY14.				
Comments	<p>NASA is retiring this APG as of FY 2014 because the program has increased significantly the number of science data products it delivers to users over the past several years. Based on this continued excellent performance, NASA has retired this measure.</p> <p>NASA is revisiting the performance measurement strategy and will add a measure for FY 2014 for the Big Earth Data Initiative during the development of FY 2015 Performance Plan.</p>				

Reported Annual Performance					
ES-12-17: Maintain a high level of customer satisfaction, as measured by exceeding the most recently available federal government average rating of the Customer Satisfaction Index.					
Contributing Theme:		Earth Science			
Contributing Program(s):		Earth Science Multi-Mission Operations			
FY07	FY08	FY09	FY10	FY11	FY12
None	8ES14 Green	9ES20 Green	10ES16 Green	ES-11-18 Green	ES-12-17 Green
Planned Annual Performance					
FY13 Update	ES-13-14: Maintain a high level of customer satisfaction, as measured by exceeding the most recently available federal government average rating of the Customer Satisfaction Index.				
FY14	ES-14-14: Maintain a high level of customer satisfaction, as measured by exceeding the most recently available federal government average rating of the Customer Satisfaction Index.				

Earth Science Delivers

NASA's [Earth Observing System Data and Information System \(EOSDIS\)](#) works to maintain high customer satisfaction in its ability to deliver data products to its customers. In FY 2012, the EOSDIS American Customer Satisfaction Index (ACSI) score was 77 out of a possible 100, the same result received each year since FY 2008. This continues to be a strong score and significantly exceeds the Federal government average of 67 (dated January 2012). EOSDIS improved in all three areas (Product Search, Selection and Order, and Documentation) recommended in the 2011 report by the Claes-Fornell International (CFI) Group.

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ACSI is a leading national indicator of customer satisfaction for more than 225 companies and over 200 customer programs, services, and Web sites at 130 Federal agencies. CFI Group conducts this survey under contract with the Department of Interior's [Federal Consulting Group](#). Based on these consistent scores, the Federal Consulting Group recognized EOSDIS in January 2012 for its "committed and comprehensive approach to assessing and improving the satisfaction of world-wide customers obtaining science data, products, tools and services to advance the study of Earth from space." The 2012 final report from CFI Group was released in November.

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OUTCOME 2.2: UNDERSTAND THE SUN AND ITS INTERACTIONS WITH THE EARTH AND THE SOLAR SYSTEM.

Billions of years ago, at the core of the Sun, a nuclear furnace ignited. The energy the Sun provides, radiated almost constantly from its visible surface, is the basis of all advanced life on Earth. The Sun is a variable star, and its waxing and waning magnetic activity is the driver of space weather at Earth and across the solar system. Earth and the other planets reside in the extended atmosphere of the Sun. This extended atmosphere, called the heliosphere, comprises a plasma “soup” of electrified and magnetized matter entwined with penetrating radiation and energetic particles.

NASA’s [Heliophysics Division](#) conducts missions that study the Sun, heliosphere, and planetary atmospheres as a single interconnected system. By analyzing these interconnections, scientists uncover fundamental physical processes that occur throughout the universe. These missions also improve capabilities for predicting the impacts of solar variability on human technological systems and safeguarding human and robotic space explorers outside the protective cocoon of Earth’s atmosphere.

NASA’s research in heliophysics has improved the understanding of space weather. NASA partners with [National Oceanic and Atmospheric Administration \(NOAA\)](#) to serve the Nation’s need for reliable space weather information. NASA spacecraft, equipped with space weather beacons, provide real-time data to NOAA space weather forecasters. NASA cooperates with other agencies to enable new knowledge in this area and to measure conditions in space critical to both operations and scientific research.

Providing National Scientific Capabilities for Heliophysics

NASA continues to develop the Nation’s capabilities in support of these science objectives by funding research and mission development performed by scientists and engineers at universities, research centers, private sector organizations, and NASA Centers. The vast majority of research awards also include funding for postdoctoral fellows, graduate students, and undergraduate students, thereby supporting the education and training of future scientists and engineers.

Programs and activities serving this goal in FY 2012 include:

- Basic technology development in detector systems, plasma physics and materials sciences;
- Suborbital rocket RockSat program;
- Postdoctoral and early career Earth and Space Science Fellowships, Jack Eddy Heliophysics Postdoctoral Fellowship Program, and the Heliophysics Summer School;
- Presidential Early Career Award for Scientists and Engineers;
- Hands-on Project Experience; and
- Heliophysics textbook development.

The establishment, operation, and maintenance of necessary facilities is critical to the Nation’s scientific capabilities. In FY 2012, NASA provided:

- Mission operations, basic data analysis, and resources for the operation centers for the [Voyager](#), [IBEX](#), [Geotail](#), [Cluster](#), [RHESSI](#), [TIMED](#), [AIM](#), [STEREO](#), [THEMIS](#), [ARTEMIS](#),

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- [Hinode](#), [SDO](#), [TWINS](#), [CINDI](#), [Wind](#), [ACE](#), [SOHO](#), and [Van Allen Probes](#) missions;
- Data archives that capture all NASA heliophysics data and provide open access to the science community and the public: the Solar Data Analysis Center, Joint Science Operations Center, Virtual Observatories, Heliophysics Data Environment Enhancements, and the Space Physics Data Facility, the integrated Space Weather Analysis system (iSWA) that captures and makes publically available NASA/Heliophysics real-time data;
 - Operation of the Nation’s scientific suborbital sounding rocket facilities; and
 - Support for the Community Coordinated Modeling Center for the testing, verification, and validation of the latest heliophysics models.

NASA requires that all funded research investigations publish their results in open, peer reviewed science literature, ensuring that data and knowledge are captured. Each year, the Heliophysics Subcommittee of NASA’s external advisory Science Committee evaluates the progress made by NASA toward each science objective. In FY 2012, the subcommittee found that expectations had been fully met by research results that included those discussed below.

Reported Multi-Year Performance

Multi-Year Performance Goal 2.2.1.1: Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base. (In support of objective 2.2.1: "Improve understanding of the fundamental physical processes of the space environment from the Sun to Earth, to other planets, and beyond to the interstellar medium.")

FY11	During FY 2012, NASA supported the development of the Nation’s scientific capabilities in this heliophysics science area through many efforts, including early career fellowships, low cost access to space suborbital rockets, and the data and modeling centers.
Green	
FY12	<p>Voyager and IBEX probe the heliosphere’s interaction with the local interstellar medium</p> <p>As the Sun moves through the local interstellar medium, the solar wind carves out a cavity known as the heliosphere that protects Earth from harmful galactic cosmic radiation. The Interstellar Boundary Explorer (IBEX) measures energetic neutral atoms created by the interaction between interstellar neutral gas and energetic protons near the edge of the solar system, as well as the interstellar neutral gas that flows directly into the inner solar system. Simultaneously, the Voyager spacecraft provide direct measurements of particles, plasmas, and magnetic fields in the heliosheath, the boundary region between the heliosphere and the interstellar medium. IBEX has measured the speed of the Sun through the local interstellar medium much more precisely than before. The Sun moves at 52,000 miles per hour, roughly 7,000 miles per hour slower and in a somewhat different direction than previously thought. These observations also show that oxygen is roughly half as abundant in the local interstellar medium as in the solar system, which suggests that either large amounts of oxygen atoms are embedded in interstellar dust grains or Earth’s solar system was born outside the local interstellar cloud. At this speed, the Sun and heliosphere create a bow wave rather than a bow shock in the interstellar medium.</p> <p>In the meantime, the Voyager 1 spacecraft entered a new, unexplored region between the solar system and interstellar space in which the solar wind has slowed down to be essentially stagnant, the solar system's magnetic field is piled up, and higher-energy</p>
Green	

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	<p>particles from inside the solar system appear to be leaking out into interstellar space. This lends further credence to the notion that the Sun's distant magnetic field may consist of bubbles approximately 100 million miles wide that are somehow disconnected from the Sun's magnetic field. These new observations have forced a re-examination of scientists' understanding of the location and nature of the heliosphere's interaction with the galactic environment, which will lead to better understanding of how galactic cosmic rays enter and penetrate deep into the solar system. (Read more about this story.)</p> <p>Long-term changes and trends in the Earth's atmosphere and ionosphere</p> <p>NASA researchers, in cooperation with the international scientific community, reviewed long-duration records of the upper atmosphere. They used data from the NASA Thermosphere, Ionosphere, Mesosphere, Energetics and Dynamics (TIMED) satellite, along with ground-based Global Positioning Satellite (GPS) receivers, radars, and lidars, to identify long-term trends in the temperature, composition and density of Earth's upper atmosphere between about 50 and 500 kilometers above the ground. More than 20 years ago, researchers predicted that global cooling would occur in the upper atmosphere. This cooling trend and an associated contraction of Earth's upper atmosphere were finally confirmed with this set of correlative observations. The increasing concentration of greenhouse gases, along with other processes such as stratospheric ozone depletion, Earth's slowly changing magnetic field, and drifting weather patterns, all exhibit long-term changes in addition to those due to solar activity. Researchers are now quantifying and understanding changes occurring at all altitudes within Earth's coupled atmospheric system, including those regions extending into the near space environment. (Read more on this story.)</p>
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Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
HE-12-1: Demonstrate planned progress in understanding the fundamental physical processes of the space environment from the Sun to Earth, to other planets, and beyond to the interstellar medium. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.					
Contributing Theme:		Heliophysics			
Contributing Program(s):		Multiple Programs			
FY07	FY08	FY09	FY10	FY11	FY12
7ESS13	8HE01	9HE1	10HE01	HE-11-1	HE-12-1
Green	Green	Green	Green	Green	Green

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Planned Annual Performance	
FY13 Update	HE-13-1: Demonstrate planned progress in understanding the fundamental physical processes of the space environment from the Sun to Earth, to other planets, and beyond to the interstellar medium. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.
FY14	HE-14-1: Demonstrate planned progress in understanding the fundamental physical processes of the space environment from the Sun to Earth, to other planets, and beyond to the interstellar medium. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.

Reported Annual Performance					
No annual performance goal in FY12.					
Contributing Theme:		Heliophysics			
Contributing Program(s):		Living with a Star			
FY07	FY08	FY09	FY10	FY11	FY12
7ESS14 Yellow	8HE06 Green	None	None	None	None
Planned Annual Performance					
FY13 Update	HE-13-2: Achieve mission success criteria for the Solar Dynamics Observatory (SDO).				
FY14	No annual performance goal in FY14.				

Reported Annual Performance	
No annual performance goal in FY12 or trended performance.	
Contributing Theme:	Heliophysics
Contributing Program(s):	Living with a Star
Planned Annual Performance	
FY13 Update	No annual performance goal in FY13.
FY14	HE-14-2: Achieve mission success criteria for Van Allen Probes Mission.

Reported Multi-Year Performance

Multi-Year Performance Goal 2.2.1.2: By 2015, launch two missions in support of objective 2.2.1.

FY11	<p>The purpose of this performance goal is to design, develop, and launch satellites in support of objective 2.2.1, as outlined in the NASA Science Mission Directorate's 2010 Science Plan. The launch of these missions will provide not only critical new knowledge, but will also broaden the distribution and capabilities of observation posts that are needed to study the full range of Sun-solar system connections. This combination of new heliophysics knowledge and a well-supported constellation of operating missions can facilitate the path towards an operational capability to predict space weather.</p> <p>NASA launched the first mission in support of this performance goal, the two-spacecraft Radiation Belt Storm Probes (RBSP), on August 30, 2012. Following on-orbit checkout, the mission was renamed the Van Allen Probes. The mission will observe the fundamental processes that energize and transport radiation belt electrons and ions in Earth's inner magnetosphere, the area in and around Earth's radiation belts. These observations will</p>
Green	
FY12	
Green	

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	<p>provide new knowledge on the dynamics and extremes of the radiation belts that are important to all technological systems that fly in and through geospace.</p> <p>NASA plans to launch the second mission, Magnetospheric Multiscale (MMS) by 2015. The MMS mission will use Earth's magnetosphere as a laboratory to study the microphysics of magnetic reconnection, a fundamental plasma-physical process that converts magnetic energy into heat and the kinetic energy of charged particles. On August 30, NASA completed the MMS System Integration Review, giving the project the go-ahead to integrate the systems into the spacecraft bus for testing and keeping this performance goal on track for completion by 2015. A subsequent review gave MMS approval to proceed into assembly, integration, and testing.</p>
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Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
HE-12-2: Complete the Magnetospheric MultiScale (MMS) Systems Integration Review.					
Contributing Theme:		Heliophysics			
Contributing Program(s):		Solar Terrestrial Probes			
FY07	FY08	FY09	FY10	FY11	FY12
7ESS15 Red	8HE02 Green	9HE2 Green	10HE02 Green	HE-11-2 Green	HE-12-2 Green

Planned Annual Performance	
FY13 Update	HE-13-3: Complete integration of the payload to the Magnetospheric Multiscale (MMS) satellite #1 (of four).
FY14	HE-14-3: Complete Magnetospheric MultiScale (MMS) Observatory #4 Environmental Test.

Reported Annual Performance					
HE-12-3: Complete the Geospace Radiation Belt Storm Probes Launch Readiness Review.					
Contributing Theme:		Heliophysics			
Contributing Program(s):		Living with a Star			
FY07	FY08	FY09	FY10	FY11	FY12
7ESS16 Green	8HE04 Green	9HE3 Green	10HE03 Green	HE-11-3 Green	HE-12-3 Green

Planned Annual Performance	
FY13 Update	No annual performance goal in FY13.
FY14	No annual performance goal in FY14.
Comments	NASA successfully launched the Geospace Radiation Belt Storm Probes spacecraft, now called the Van Allen Probes, on August 30, 2012. The Van Allen Probes will contribute scientific data in support of performance goals 2.2.1.1 and 2.2.2.1 through FY 2014, when it will conclude its prime mission. At that time NASA will evaluate whether the Van Allen Probes achieved its mission success criteria.

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Reported Multi-Year Performance

Multi-Year Performance Goal 2.2.2.1: Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base. (In support of objective 2.2.2: "Improve understanding of how human society, technological systems, and the habitability of planets are affected by solar variability interacting with planetary magnetic fields and atmospheres.")

FY11	<p>During FY 2012, NASA supported the development of the Nation’s scientific capabilities in this heliophysics science area through many efforts, including early career fellowships, Living With a Star Targeted Research and Technology Programs, and the Community Coordinated Modeling Center, a facility that is open for researchers to provide the latest Heliophysics models for testing, verification and validation.</p>
Green	
FY12	
Green	

Discovery of energetic late-phase emissions from solar flares and their impact on the Earth’s upper atmosphere

Solar flares are intense bursts of highly energetic radiation caused by the release of magnetic energy associated with sunspot regions. When the energy from eruptive flares, the largest explosive events in the solar system, impacts Earth’s atmosphere, it alters the atmospheric structure, which in turn can affect the efficient operation of Earth-orbiting communication and navigation satellites. In particular, the energetic ultraviolet to X-ray emission from flares adds additional heat to Earth’s upper atmosphere. Solar flares continue to surprise: observations by the [Solar Dynamics Observatory \(SDO\)](#) and the [Reuven Ramaty High Energy Solar Spectroscopic Imager \(RHESSI\)](#) revealed that a substantial fraction (about 15 percent) of flares have a pronounced "late phase" that can pump more than 40 percent of the total energy out into space than previously realized. The [Thermosphere, Ionosphere, Mesosphere, Energetics and Dynamics \(TIMED\)](#) mission measured the impact of a powerful solar flare in March 2012, also measured by SDO, on Earth’s upper atmosphere. In direct response to the energy input from the flare, the upper atmosphere was observed to heat up, resulting in increased infrared emission by molecules including nitric oxide and carbon dioxide. These unique Heliophysics System Observatory observations demonstrate the substantial sensitivity of Earth's atmosphere to short- and long-term variability of the Sun. (Read more about the [SDO and RHESSI](#) research and the [TIMED research](#).)

Imaging magnetospheric dynamics tracks the impact of solar disturbances

Imaging the rarified plasmas and magnetic fields of Earth’s magnetosphere has long eluded scientists. The absence of global images has made the large-scale dynamics of the region much more difficult to unravel and understand. Recently two spacecraft within the Heliophysics System Observatory have turned their high-resolution cameras on the magnetosphere and directly observed its complex flows. The cameras on the [Two Wide-Angle Imaging Neutral-Atom Spectrometers \(TWINS\)](#) and [IBEX](#) both detect energetic neutral atoms (ENAs) rather than light. ENAs are created when fast moving protons hit neutral atoms. The two spacecraft observed the magnetosphere from different perspectives, providing a comprehensive stereo view during the April 5, 2010, geomagnetic disturbance. From outside, IBEX showed that the magnetosphere was immediately compressed by the impact of an interplanetary shock wave. About 15 minutes later, one of the TWINS spacecraft located inside the magnetosphere observed energetic particles trapped in the ring current, an electric current that appears 20,000 miles above the surface of Earth during geomagnetic disturbances. These new observations provide a new global perspective and highlight the importance of ENAs for remotely observing the impacts of interplanetary disturbances on Earth’s magnetosphere. (Read more about [this story](#).)

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Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
HE-12-4: Demonstrate planned progress in understanding how human society, technological systems, and the habitability of planets are affected by solar variability interacting with planetary magnetic fields and atmospheres. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.					
Contributing Theme:		Heliophysics			
Contributing Program(s):		Multiple Programs			
FY07	FY08	FY09	FY10	FY11	FY12
7ESS19	8HE03	9HE6	10HE06	HE-11-4	HE-12-4
Green	Green	Green	Green	Green	Green
Planned Annual Performance					
FY13 Update	HE-13-4: Demonstrate planned progress in understanding how human society, technological systems, and the habitability of planets are affected by solar variability interacting with planetary magnetic fields and atmospheres. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.				
FY14	HE-14-4: Demonstrate planned progress in understanding how human society, technological systems, and the habitability of planets are affected by solar variability interacting with planetary magnetic fields and atmospheres. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.				

Reported Annual Performance					
No annual performance goal in FY12.					
Contributing Theme:		Heliophysics			
Contributing Program(s):		Living with a Star			
FY07	FY08	FY09	FY10	FY11	FY12
7ESS14	8HE06	None	None	None	None
Yellow	Green				
Planned Annual Performance					
FY13 Update	HE-13-2: Achieve mission success criteria for the Solar Dynamics Observatory (SDO).				
FY14	No annual performance goal in FY14.				

Reported Annual Performance	
No annual performance goal in FY12 or trended performance.	
Contributing Theme:	Heliophysics
Contributing Program(s):	Living with a Star

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Planned Annual Performance	
FY13 Update	No annual performance goal in FY13.
FY14	HE-14-2: Achieve mission success criteria for Van Allen Probes Mission.

Reported Multi-Year Performance

Multi-Year Performance Goal 2.2.2.2: By 2015, launch two missions in support of objective 2.2.2.

FY11	<p>The purpose of this performance goal is to design, develop, and launch satellites in support of objective 2.2.1, as outlined in the NASA Science Mission Directorate's 2010 Science Plan. The launch of these missions will provide not only critical new knowledge but will also broaden the distribution and capabilities of observation posts that are needed to study the full range of Sun-solar system connections. This combination of new heliophysics knowledge and a well-supported constellation of operating missions can facilitate the path towards an operational capability to predict space weather.</p> <p>NASA launched the first mission in support of this performance goal, the two-spacecraft Van Allen Probes. NASA plans to launch the second mission, MMS, by 2015.</p>
Green	
FY12	
Green	

Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
HE-12-2: Complete the Magnetospheric MultiScale (MMS) Systems Integration Review.					
Contributing Theme:		Heliophysics			
Contributing Program(s):		Solar Terrestrial Probes			
FY07	FY08	FY09	FY10	FY11	FY12
7ESS15 Red	8HE02 Green	9HE2 Green	10HE02 Green	HE-11-2 Green	HE-12-2 Green
Planned Annual Performance					
FY13 Update	HE-13-3: Complete integration of the payload to the Magnetospheric Multiscale (MMS) satellite #1 (of four).				
FY14	HE-14-3: Complete Magnetospheric MultiScale (MMS) Observatory #4 Environmental Test.				

Reported Annual Performance					
HE-12-3: Complete the Geospace Radiation Belt Storm Probes Launch Readiness Review.					
Contributing Theme:		Heliophysics			
Contributing Program(s):		Living with a Star			
FY07	FY08	FY09	FY10	FY11	FY12
7ESS16 Green	8HE04 Green	9HE3 Green	10HE03 Green	HE-11-3 Green	HE-12-3 Green
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	No annual performance goal in FY14.				

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Comments	NASA successfully launched the Geospace Radiation Belt Storm Probes spacecraft, now called the Van Allen Probes, on August 30, 2012. The Van Allen Probes will contribute scientific data in support of performance goals 2.2.1.1 and 2.2.2.1 through FY 2014, when it will conclude its prime mission. At that time NASA will evaluate whether the Van Allen Probes achieved its mission success criteria.
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Reported Annual Performance	
No annual performance goal in FY12 or trended performance.	
Contributing Theme:	Heliophysics
Contributing Program(s):	Living with a Star
Planned Annual Performance	
FY13 Update	HE-13-6: Complete the Solar Orbiter Collaboration Mission Confirmation Review.
FY14	HE-14-5: Complete Solar Orbiter Collaboration Heavy Ion Sensor (HIS) Instrument Critical Design Review.

Reported Annual Performance					
No annual performance goal in FY12.					
Contributing Theme:		Heliophysics			
Contributing Program(s):		Living with a Star			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	10HE04 Green	None	None
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	HE-14-6: Complete Solar Probe Plus Preliminary Design Review.				

Reported Multi-Year Performance

Multi-Year Performance Goal 2.2.3.1: Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base. (In support of objective 2.2.3: "Maximize the safety and productivity of human and robotic explorers by developing the capability to predict extreme and dynamic conditions in space.")

FY11	During FY 2012, NASA supported the development of the Nation's scientific capabilities in this heliophysics science area through many efforts, including early career fellowships, Living With a Star Targeted Research and Technology Programs , and the integrated Space Weather Analysis system that captures and makes publically available NASA/Heliophysics real-time data.
Green	
FY12	<p>New observations enable advanced detection of sunspots beneath the sun's surface</p> <p>Long visible to the (protected) human eye as dark blemishes on the solar disk, sunspot regions are the birthplaces of massive, highly energetic solar explosions (flares and coronal mass ejections). When these eruptions reach Earth, they can generate beautiful aurorae but also can wreak havoc on satellites, communications, and electric power grids. A key goal of the Heliophysics program is to reliably predict the occurrence and strength of these</p>
Green	

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eruptions, long before they reach our vulnerable planet. For longer-term forecasting, scientists must reliably detect sunspot regions well before they emerge onto the surface from deep within the Sun. Scientists know that sunspot regions are planet-sized bundles of strong, twisted magnetic field that rise like bubbles until they breach the solar surface, but until recently they could not predict when or where they would appear. Exciting new research with instruments onboard two NASA spacecraft, the long-serving [Solar and Heliospheric Observatory \(SOHO\)](#) and the newer [SDO](#), has detected sunspot regions while they are still submerged and invisible to ordinary telescopes. The analysis technique, called "time-distance helioseismology," is similar to an approach widely used in earthquake studies. Just as seismic waves traveling through Earth reveal the inner workings of Earth, sound waves traveling through the Sun can reveal what is inside the star. Submerged magnetic-field bundles affect the Sun's inner acoustics in ways that can now be calculated, revealing the presence of hidden sunspot regions just as the medical sciences use ultrasound scans. This revolutionary technique is most sensitive to large sunspot regions when they are located about 60,000 kilometers (nearly five times Earth's diameter) beneath the Sun's surface, providing up to two days' advance notice that a strong magnetic field is about to emerge. Because larger sunspot regions are more likely to produce the most powerful solar explosions, this research holds great promise for enabling adverse space weather to be forecast in time to mitigate or prevent harmful effects, days before the explosions will actually occur. (Read more about [this story](#).)

Unraveling the mystery of disappearing radiation belt electrons

The content of very high-energy electrons that populate the Van Allen Radiation Belts regularly increases and decreases due to changes in the solar wind. Understanding how charged particles leave the belts is critical to developing accurate models that will predict hazards to spacecraft and astronauts. Dramatic dropouts in the Van Allen belts' content can occur at various times during magnetic storms, in some cases when electrons, pushed by waves, rain on the atmosphere. A team of researchers has now unraveled another major cause of electron dropouts. Using measurements from a network of satellites passing through the radiation belts (the [Time History of Events and Macroscale Interactions during Substorms \(THEMIS\)](#) satellite and the [Geostationary Operational Environmental Satellite \(GOES\)](#) probes in equatorial orbit and the [Polar Orbiting Environmental Satellites \(POES\)](#) in low-altitude polar orbit) the team showed that, at the onset of a geomagnetic storm, the majority of lost electrons are swept out into interplanetary space instead of raining into the atmosphere. (Read more about [this story](#).)

Update to Multi-Year Performance Goal

FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

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Reported Annual Performance					
HE-12-5: Demonstrate planned progress in maximizing the safety and productivity of human and robotic explorers by developing the capability to predict the extreme and dynamic conditions in space. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.					
Contributing Theme:		Heliophysics			
Contributing Program(s):		Multiple Programs			
FY07	FY08	FY09	FY10	FY11	FY12
7ESS20 Green	8HE05 Green	9HE8 Green	10HE08 Green	HE-11-5 Green	HE-12-5 Green
Planned Annual Performance					
FY13 Update	HE-13-5: Demonstrate planned progress in maximizing the safety and productivity of human and robotic explorers by developing the capability to predict the extreme and dynamic conditions in space. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.				
FY14	HE-14-7: Demonstrate planned progress in maximizing the safety and productivity of human and robotic explorers by developing the capability to predict the extreme and dynamic conditions in space. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.				

Reported Multi-Year Performance

Multi-Year Performance Goal 2.2.3.2: By 2017, launch at least two missions in support of objective 2.2.3.

FY11	<p>The purpose of this performance goal is to design, develop, and launch satellites in support of objective 2.2.1, as outlined in the NASA Science Mission Directorate's 2010 Science Plan. The launch of these missions will provide not only critical new knowledge but will also broaden the distribution and capabilities of observation posts that are needed to study the full range of Sun-solar system connections. This combination of new heliophysics knowledge and a well-supported constellation of operating missions can facilitate the path towards an operational capability to predict space weather.</p> <p>NASA launched the first mission in support of this performance goal, the two-spacecraft Radiation Belt Storm Probes, on August 30, 2012. NASA renamed the mission Van Allen Probes once the spacecraft were on orbit and operational.</p> <p>The second mission, Solar Orbiter, a collaborative mission with the European Space Agency, is planned for launch in 2017, and will venture closer to the Sun than any previous mission. Solar Orbiter will explore the near-Sun environment to improve the understanding of the origins of the solar wind streams and the heliospheric magnetic field, the sources, acceleration mechanisms, and transport processes of solar energetic particles, and the evolution of coronal mass ejections in the inner heliosphere. The mission will provide better insight into the evolution of sunspots, active regions, coronal holes, and other solar features and phenomena.</p>
Green	
FY12	
Green	

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Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
HE-12-3: Complete the Geospace Radiation Belt Storm Probes Launch Readiness Review.					
Contributing Theme:		Heliophysics			
Contributing Program(s):		Living with a Star			
FY07	FY08	FY09	FY10	FY11	FY12
7ESS16 Green	8HE04 Green	9HE3 Green	10HE03 Green	HE-11-3 Green	HE-12-3 Green
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	No annual performance goal in FY14.				
Comments	NASA successfully launched the Geospace Radiation Belt Storm Probes spacecraft, now called the Van Allen Probes, on August 30, 2012. The Van Allen Probes will contribute scientific data in support of performance goals 2.2.1.1 and 2.2.2.1 through FY 2014, when it will conclude its prime mission. At that time NASA will evaluate whether the Van Allen Probes achieved its mission success criteria.				

Reported Annual Performance	
No annual performance goal in FY12 or trended performance.	
Contributing Theme:	Heliophysics
Contributing Program(s):	Living with a Star
Planned Annual Performance	
FY13 Update	HE-13-6: Complete the Solar Orbiter Collaboration Mission Confirmation Review.
FY14	HE-14-5: Complete Solar Orbiter Collaboration Heavy Ion Sensor (HIS) Instrument Critical Design Review.

Reported Annual Performance					
No annual performance goal in FY12.					
Contributing Theme:		Heliophysics			
Contributing Program(s):		Living with a Star			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	10HE04 Green	None	None
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	HE-14-6: Complete Solar Probe Plus Preliminary Design Review.				

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OUTCOME 2.3: ASCERTAIN THE CONTENT, ORIGIN, AND EVOLUTION OF THE SOLAR SYSTEM AND THE POTENTIAL FOR LIFE ELSEWHERE.

[Planetary Science](#)'s missions have revolutionized understanding of the origin and history of the solar system. NASA has missions circling the innermost planet, Mercury, and heading for the outer reaches of the solar system, where Pluto orbits among other Kuiper Belt objects. Its missions have orbited and roved the surface of Mars, finding evidence of liquid water. Closer to home, Planetary Science uses ground-based sensors in coordination with the [National Science Foundation](#) and the [U.S. Air Force](#) to survey the volume of near-Earth space to detect, track, catalog, and characterize near-Earth objects that may either pose hazards to Earth or provide destinations and resources for future exploration.

NASA's robotic science missions are paving the way for understanding the origin and evolution of the solar system and identifying past and present habitable locations. With this knowledge, NASA is enabling human space exploration by studying and characterizing planetary environments beyond Earth and identifying possible resources that will enable safe and effective human missions to destinations beyond low Earth orbit.

Robotic explorers gather data to help scientists understand how the planets formed, what triggered different evolutionary paths among planets, what processes are active, and how Earth formed, evolved, and became habitable. To search for evidence of life beyond Earth, scientists use this data to map zones of habitability, study the chemistry of unfamiliar worlds, and unveil the processes that lead to conditions necessary for life.

Providing National Scientific Capabilities in Planetary Sciences

NASA continues to develop the Nation's capabilities in support of NASA's science objectives by funding research and mission development performed by scientists and engineers at universities, research centers, private sector organizations, and NASA Centers. The majority of research awards also include funding for postdoctoral fellows, graduate students, and undergraduate students, thereby supporting the education and training of future scientists and engineers.

Programs and activities serving this goal in FY 2012 include:

- The Research Opportunities in Space and Earth Science annual solicitation;
- Basic technology development in instrumentation and power systems;
- Graduate student, postdoctoral and early career Earth and space science fellowships;
- Presidential Early Career Award for Scientists and Engineers;
- Hands-on Project Experience; and
- Venus Transit public educational and viewing event.

The establishment, operation, and maintenance of necessary facilities is critical to the Nation's scientific capabilities. In FY 2012, NASA provided:

- Operations, basic data analysis, and resources for operation centers for the [MSL Curiosity](#), [Cassini](#), [Dawn \(now ended\)](#), [LRO](#), [New Horizons](#), the [Mars Exploration Rover Opportunity](#), [MRO](#), [Juno](#), [MESSENGER](#), [Mars Odyssey](#), and [GRAIL \(now ended\)](#) missions;

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- The Planetary Data System (PDS), which archives all NASA planetary science mission data and provides open access to the science community and the public through the PDS discipline nodes, including Atmospheres, Geosciences, Imaging, Navigational and Ancillary Information, Planetary Plasma Interactions, Planetary Rings, and Small Bodies;
- Facilities operation of ground-based [Infrared Telescope Facility](#) and Keck Observatories and Astromaterials Curation, including lunar and extraterrestrial specimens; and
- Support for the [NASA Astrobiology Institute](#), the [NASA Lunar Science Institute](#), and analysis working groups providing cross-disciplinary community engagement and research collaborations.

NASA requires that all funded research investigations publish their results in open, peer reviewed science literature, ensuring that data and knowledge are captured. Each year, the Planetary Science Subcommittee of NASA’s external advisory Science Committee evaluates the progress made by NASA toward each science objective. In FY 2012, the subcommittee found that expectations had been fully met by research results that included those discussed below.

Reported Multi-Year Performance

Multi-Year Performance Goal 2.3.1.1: Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base. (In support of objective 2.3.1: "Inventory solar system objects and identify the processes active in and among them.")

FY11	NASA provides the skilled researchers and supporting planetary science knowledge base necessary for the Nation’s scientific capabilities as detailed.
Green	
FY12	<p>Dawn at Vesta</p> <p>The Dawn spacecraft completed its observations at the giant asteroid Vesta. The results from Dawn warranted an entire issue of <i>Science</i> (May 11, 2012) dedicated to the new findings. Results show asteroid Vesta has geomorphological features such as varied topography and depositional and erosional environments indicating active surface processes. Data from the Dawn spacecraft reveal Vesta to be a dwarf planet with an inner iron core like the Moon and rocky planets.</p> <p>Satellite of Pluto Discovered</p> <p>Researchers from NASA's New Horizons mission to Pluto used the Hubble Space Telescope to discover a fifth moon orbiting Pluto in images taken during June–July 2012. The moon, tentatively called "P5," has a diameter of about 15 kilometers, making it the smallest and faintest of Pluto's moons yet discovered. The image of the new moon and other images will enable the mission team to assess the safety of several candidate trajectories for New Horizons as it passes near Pluto in July 2015.</p> <p>Can a Moon Have a Moon? Saturn’s Mysterious Iapetus May Have Had One</p>
Green	

PERFORMANCE REPORTING AND PLANNING

	Two NASA-funded research groups proposed that Iapetus, Saturn’s outermost major moon, once had its own satellite. Both groups propose that this “subsattellite” was formed by collision with another moon during Iapetus’ formation. The research groups are investigating the fate of the lost moon. One team suggests that the subsattellite spiraled out from Iapetus and was responsible for Iapetus’ very slow spin before ultimately being lost. The other research team proposes that the subsattellite ultimately spiraled back toward Iapetus, breaking up into a debris ring, and forming the equatorial accretion ridge.
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Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
PS-12-1: Demonstrate planned progress in inventorying solar system objects and identifying the processes active in and among them. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.					
Contributing Theme:		Planetary Science			
Contributing Program(s):		Multiple Programs			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	PS-11-1 Green	PS-12-1 Green

Planned Annual Performance	
FY13 Update	PS-13-1: Demonstrate planned progress in inventorying solar system objects and identifying the processes active in and among them. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.
FY14	PS-14-1: Demonstrate planned progress in inventorying solar system objects and identifying the processes active in and among them. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.

Reported Multi-Year Performance

Multi-Year Performance Goal 2.3.1.2: By 2017, launch at least two missions in support of objective 2.3.1.

FY11	The purpose of this performance goal is to design, develop, and launch satellites in support of objective 2.3.1, as outlined in the NASA Science Mission Directorate’s 2010 Science Plan . NASA selected the Origins-Spectral Interpretation-Resource Identification-Security-Regolith Explorer, or OSIRIS-REx , project in FY 2011 through a NASA Announcement of Opportunity. Planned for launch in 2016, it will be the first U.S. mission to bring samples from an asteroid back to Earth. The project team chose to extend the formulation phase, which will help reduce mission risk. OSIRIS-REx successfully conducted a Mission Design Review on May 8-10, 2012. The Preliminary Design Review initially planned for FY 2012 will be held in March 2013.
Green	
FY12	NASA selected the second mission serving this performance goal in August 2012 from three Discovery 12 concept studies. Also planned for launch in 2016, InSight will take the first look into the deep interior of Mars to see why it evolved differently as a terrestrial planet from Earth.
Green	

PERFORMANCE REPORTING AND PLANNING

Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
PS-12-2: Complete New Frontiers 3 Preliminary Design Review.					
Contributing Theme:		Planetary Science			
Contributing Program(s):		New Frontiers			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	10PS04 Green	PS-11-3 Green	PS-12-2 Yellow
Why this APG was not achieved:					
At the time of the performance plan update, NASA had not completed the final negotiation on the procurement the Origins Spectral Interpretation Resource Identification Security Regolith Explorer (OSIRIS-REx) mission. The final agreement resulted in a proposed extended Phase B for the OSIRIS-REx project, which moved the Preliminary Design Review (the APG milestone) beyond fiscal year 2012, with the planned completion of the Mission Definition Review in FY 2012 instead. NASA made this change to reduce risk to cost and schedule performance for the project.					
Planned Annual Performance					
FY13 Update	PS-13-5: Complete the OSIRIS-REx Preliminary Design Review (PDR).				
FY14	PS-14-2: Complete the OSIRIS REx Critical Design Review (CDR).				

Reported Annual Performance					
PS-12-3: Complete the Discovery 12 mission concept studies.					
Contributing Theme:		Planetary Science			
Contributing Program(s):		Discovery			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	None	PS-12-3 Green
Planned Annual Performance					
FY13 Update	PS-13-2: Initiate the preliminary design for the Discovery 12 mission.				
FY14	PS-14-3: Complete InSight Mission (Discovery 12) Critical Design Review.				

PERFORMANCE REPORTING AND PLANNING

Reported Multi-Year Performance

Multi-Year Performance Goal 2.3.2.1: Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base. (In support of objective 2.3.2: "Improve understanding of how the Sun's family of planets, satellites, and minor bodies originated and evolved.")

FY11	NASA provides the skilled researchers and supporting planetary science knowledge base necessary for the Nation's scientific capabilities.
Green	
FY12	<p>LRO Reveals Scars of Lunar Tectonics</p> <p>Scars observed on the Moon by NASA's Lunar Reconnaissance Orbiter (LRO) suggest that the Moon was not fully molten when it first formed. Cooling of a fully melted moon would have erased any localized stretching that formed the features seen today. With the recent imaging capability of the high-resolution camera onboard LRO, new discoveries about the formation of the Moon are coming into focus. High-resolution images show a recent graben, or depression, bordered by parallel faults formed by tectonics, leaving a scar on the lunar surface. The graben is less than 50 million years old based on its lack of craters and micrometeorite infill.</p> <p>GRAIL Redefines The Lunar Gravity Field</p> <p>The most accurate global gravity model of the Moon to date has been developed from the first three months of Gravity Recovery and Interior Laboratory (GRAIL) data, with surface resolution as small as 23 kilometers. The new model reveals a much more detailed lunar landscape, particularly over the lunar far side, showing the gravity signals of craters and basins not seen before and with an accuracy at least an order of magnitude more precise than any previous model. This data also reveal lunar surface features and provide measurements of the interior composition, subsurface structure, and the lunar thermal history.</p> <p>Volatile-rich Terrains on Mercury</p> <p>The MESSENGER spacecraft has sent back a wealth of data from the innermost planet. One of the major discoveries from orbit is of "hollows," shallow, rimless, irregularly shaped depressions found in impact craters all over Mercury. The strange landforms can be tens of meters to a few kilometers wide. The origin of the hollows is not yet known, but one of the most likely formation mechanisms involves recent loss of volatiles through some combination of sublimation, space weathering, outgassing, or pyroclastic volcanism. These features support the inference that Mercury's interior contains higher abundances of volatile materials than predicted by most scenarios for the formation of the solar system's innermost planet. Although Mercury was thought to be relatively old and dead, MESSENGER images of the hollows show that parts of it may be active today.</p>
Green	

Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

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Reported Annual Performance					
PS-12-4: Demonstrate planned progress in understanding how the Sun's family of planets, satellites, and minor bodies originated and evolved. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.					
Contributing Theme:		Planetary Science			
Contributing Program(s):		Multiple Programs			
FY07	FY08	FY09	FY10	FY11	FY12
7SSE1 Green	8PS01 Green	9PS1 Green	10PS01 Green	PS-11-4 Green	PS-12-4 Green
Planned Annual Performance					
FY13 Update	PS-13-3: Demonstrate planned progress in understanding how the Sun's family of planets, satellites, and minor bodies originated and evolved. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.				
FY14	PS-14-4: Demonstrate planned progress in understanding how the Sun's family of planets, satellites, and minor bodies originated and evolved. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.				

Reported Annual Performance					
PS-12-5: Complete MESSENGER mission success criteria.					
Contributing Theme:		Planetary Science			
Contributing Program(s):		Discovery			
FY07	FY08	FY09	FY10	FY11	FY12
7SSE2 Green	8PS02 Green	None	None	PS-11-5 Green	PS-12-5 Green
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	No annual performance goal in FY14.				

Reported Multi-Year Performance

Multi-Year Performance Goal 2.3.2.2: By 2015, launch at least three missions in support of objective 2.3.2.

FY11	<p>The purpose of this performance goal is to design, develop, and launch satellites in support of objective 2.3.2, as outlined in the NASA Science Mission Directorate's 2010 Science Plan. On August 5, 2011, NASA launched the first mission, Juno, supporting this performance goal. It is on its way to the largest planet in the solar system, Jupiter, to collect data that will help scientists better understand how this gas giant planet formed and evolved. Shortly into FY 2013, Juno headed back toward the inner solar system to fly past Earth, gaining a gravity boost that sped it toward Jupiter.</p> <p>NASA also is researching solar system bodies closer to home in support of its science objectives. On September 10, 2011, NASA launched the twin GRAIL spacecraft into orbit around the Moon to map lunar gravity and use that information to increase understanding of the Moon's interior and thermal history. By May 2012, GRAIL had accomplished its mission success criteria.</p>
Green	
FY12	
Green	

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	The third mission also will be focused on lunar research. NASA completed the Delta-Systems Integration Review for the Lunar Atmosphere and Dust Environment Explorer (LADEE) on August 9, 2012, giving the project the go-ahead to integrate the systems into the spacecraft bus and begin testing. LADEE is planned for launch in late 2013, within the completion timeframe for this performance goal. LADEE will orbit the Moon to gather detailed information about the lunar atmosphere, conditions near the surface, and environmental influences on lunar dust.
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Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
PS-12-2: Complete New Frontiers 3 Preliminary Design Review.					
Contributing Theme:		Planetary Science			
Contributing Program(s):		New Frontiers			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	10PS04 Green	PS-11-3 Green	PS-12-2 Yellow
Why this APG was not achieved:					
At the time of the performance plan update, NASA had not completed the final negotiation on the procurement the Origins Spectral Interpretation Resource Identification Security Regolith Explorer (OSIRIS-REx) mission. The final agreement resulted in a proposed extended Phase B for the OSIRIS-REx project, which moved the Preliminary Design Review (the APG milestone) beyond fiscal year 2012, with the planned completion of the Mission Definition Review in FY 2012 instead. NASA made this change to reduce risk to cost and schedule performance for the project.					
Planned Annual Performance					
FY13 Update	PS-13-5: Complete the OSIRIS-REx Preliminary Design Review (PDR).				
FY14	PS-14-2: Complete the OSIRIS REx Critical Design Review (CDR).				

Reported Annual Performance					
PS-12-6: Complete the Lunar Atmosphere and Dust Environment Explorer (LADEE) Systems Integration Review.					
Contributing Theme:		Planetary Science			
Contributing Program(s):		Lunar Quest			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	None	PS-12-6 Green
Planned Annual Performance					
FY13 Update	PS-13-4: Launch the Lunar Atmosphere and Dust Environment Explorer (LADEE).				
FY14	No annual performance goal in FY14.				

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Reported Annual Performance					
PS-12-18: Complete GRAIL mission success criteria.					
Contributing Theme:		Planetary Science			
Contributing Program(s):		Discovery			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	9PS3 Green	10PS03 Green	PS-11-7 Green	PS-12-18 Green
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	No annual performance goal in FY14.				

Reported Multi-Year Performance

Multi-Year Performance Goal 2.3.3.1: Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base. (In support of objective 2.3.3: "Improve understanding of the processes that determine the history and future of habitability of environments on Mars and other solar system bodies.")

FY11	NASA provides the skilled researchers and supporting planetary science knowledge base necessary for the Nation's scientific capabilities.
Green	
FY12	Mars Science Laboratory Curiosity's Roving Laboratory
Green	<p>On November 26, 2011, the Mars Science Laboratory (MSL) Curiosity rover launched from Cape Canaveral. During the eight-month journey to Mars, the Radiation Assessment Detector (RAD), an instrument designed to measure the radiation levels on Mars, measured the radiation dose and detected a solar flare during the transport to Mars. On August 6, 2012, the Mars Reconnaissance Orbiter (MRO) imaged MSL's Curiosity rover as it successfully descended and landed via the sky crane landing system.</p> <p>All of the science instruments on-board Curiosity are operating as expected. One of the earliest science highlights is from the Chemistry & Camera (ChemCam) instrument. ChemCam returned spectra from a basalt rock, demonstrating the first use of laser-based, active spectroscopy measurement for mineralogy identification on another planetary body. ChemCam imaged the ablated surface, providing magnified images of the fresh and weathered surfaces. On the drive from the Bradbury landing site toward Mt. Sharp, Curiosity investigated several rock outcrops, indicative of a streambed. For more information on MSL science results, join Curiosity on the traverse to Glenelg.</p> <p>Martian Meteorites Show Macromolecular Carbon of Non-Biological Origin</p> <p>The source and nature of carbon on Mars have been a subject of intense speculation. Recent results of spectroscopy on Martian meteorites, spanning about 4.2 billion years of Martian history, show that they contain a type of carbon that formed at high-temperature (i.e. in molten rock or magma). The association of organic carbon within magmatic minerals indicates that Martian magmas favored precipitation of reduced carbon species during crystallization. The ubiquitous distribution of this form of organic carbon in Martian rocks is important for understanding the Martian carbon cycle and has implications for future missions to detect possible past Martian life.</p>

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	<p>Mars' Interior as Wet as Earth's</p> <p>Scientists have determined that the amount of water in the interior of Mars is comparable to the amount of water in the interior of Earth. The researchers study OH, a proxy for water, in apatite. Apatite is a mineral formed at high temperature in a hydrated magma (magma and water), and found in Martian meteorites. Those meteorites containing apatite represent a range of both depleted (crustal) and enriched (mantle) material on Mars. Laboratory investigations of the water abundance needed to form apatite in synthetic rocks were compared with the two Martian meteorites. The water content needed to form apatite in these meteorites is similar to the amount of water found in Earth mantle rocks like basalts.</p>
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Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
PS-12-7: Demonstrate planned progress in understanding the processes that determine the history and future of habitability of environments on Mars and other solar system bodies. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.					
Contributing Theme:		Planetary Science			
Contributing Program(s):		Multiple Programs			
FY07	FY08	FY09	FY10	FY11	FY12
7SSE6 Green	8PS06 Green	9PS8 Green	10PS09 Green	PS-11-8 Green	PS-12-7 Green
Planned Annual Performance					
FY13 Update	PS-13-6: Demonstrate planned progress in understanding the processes that determine the history and future of habitability of environments on Mars and other solar system bodies. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.				
FY14	PS-14-5: Demonstrate planned progress in understanding the processes that determine the history and future of habitability of environments on Mars and other solar system bodies. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.				

Reported Annual Performance					
PS-12-8: Complete the Mars Science Laboratory (MSL) Launch Readiness Review.					
Contributing Theme:		Planetary Science			
Contributing Program(s):		Mars Exploration			
FY07	FY08	FY09	FY10	FY11	FY12
7SSE5 Green	8PS05 Green	9PS4 Red	10PS06 Yellow	PS-11-9 Green	PS-12-8 Green
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	PS-14-6: Achieve mission success criteria for Mars Science Laboratory (MSL).				

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Reported Multi-Year Performance

Multi-Year Performance Goal 2.3.3.2: By 2015, launch at least two missions in support of objective 2.3.3.

FY11	<p>The purpose of this performance goal is to design, develop, and launch satellites in support of objective 2.3.3, as outlined in the NASA Science Mission Directorate's 2010 Science Plan. On November 26, 2011, NASA launched the biggest, most ambitious Mars science mission ever, MSL, which carried the Curiosity rover to the surface of Mars. Enabled by numerous new technologies and advanced capabilities (including an entirely new Sky Crane landing system, a radioisotope-based power system, an advanced communications capability, autonomous robotic navigation technologies, and compact science instrumentation), MSL successfully landed on Mars on August 6. Shortly after landing, Curiosity was taking panoramic photos of its surroundings. Since then, it has been on its mission to determine if the planet has ever had an environment capable of supporting life.</p> <p>The second mission that will support this performance goal is the Mars Atmosphere and Volatile Evolution (MAVEN), planned for launch in late 2013. NASA completed the Systems Integration Review on June 28, 2012, giving the project the go-ahead to integrate the systems into the spacecraft bus and to start testing. MAVEN will orbit Mars to help determine how much of the Martian atmosphere has been lost over time. It will measure the current rate of atmospheric escape to space and gather enough information about the relevant processes to allow scientists to extrapolate backward in time.</p>
Green	
FY12	
Green	

Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance						
PS-12-3: Complete the Discovery 12 mission concept studies.						
Contributing Theme:			Planetary Science			
Contributing Program(s):			Discovery			
FY07	FY08	FY09	FY10	FY11	FY12	
None	None	None	None	None	PS-12-3 Green	
Planned Annual Performance						
FY13 Update	PS-13-2: Initiate the preliminary design for the Discovery 12 mission.					
FY14	PS-14-3: Complete InSight Mission (Discovery 12) Critical Design Review.					

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Reported Annual Performance					
PS-12-8: Complete the Mars Science Laboratory (MSL) Launch Readiness Review.					
Contributing Theme:		Planetary Science			
Contributing Program(s):		Mars Exploration			
FY07	FY08	FY09	FY10	FY11	FY12
7SSE5 Green	8PS05 Green	9PS4 Red	10PS06 Yellow	PS-11-9 Green	PS-12-8 Green
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	No annual performance goal in FY14.				
Comments	The Mars Science Laboratory spacecraft successfully launched on November 26, 2011. MSL's rover, Curiosity, is in operation on Mars, where it is collecting data in support of performance goal 2.3.3.1 through FY 2014, when it will conclude its prime mission. At that time, NASA will evaluate whether the Mars Science Laboratory achieved its mission success criteria.				

Reported Annual Performance					
PS-12-9: Complete the Mars Atmosphere and Volatile Evolution Mission (MAVEN) Systems Integration Review.					
Contributing Theme:		Planetary Science			
Contributing Program(s):		Mars Exploration			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	10PS08 Green	PS-11-10 Green	PS-12-9 Green
Planned Annual Performance					
FY13 Update	PS-13-7: Complete the Mars Atmosphere and Volatile Evolution Mission (MAVEN) Pre-Ship Review (PSR).				
FY14	PS-14-7: Launch the MAVEN mission.				

Reported Multi-Year Performance

Multi-Year Performance Goal 2.3.4.1: Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base. (In support of objective 2.3.4: "Improve understanding of the origin and evolution of Earth's life and biosphere to determine if there is or ever has been life elsewhere in the universe.")

FY11	NASA provides the skilled researchers and supporting planetary science knowledge base necessary for the Nation's scientific capabilities.
Green	
FY12	New Equatorial Lakes Appear on Titan Observations from Cassini infrared spectra suggest a hydrocarbon lake (probably methane) and a few small ponds present in the equatorial region of Titan. With the exception of Earth, Titan is the only solid object in the solar system to circulate liquids in a cycle of rain and evaporation. On Titan, the process is driven by methane rather than water. This cycle is expected to form lakes near the moon's poles, but not at its dune-covered equator, where Cassini measurements show that humidity levels are low and little rain falls to the surface.
Green	

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	<p>Any surface liquid there should evaporate and be transported to the cooler poles, where it should condense as rain. The lake is approximately 60 kilometers long and 40 kilometers wide, and at least one meter deep. The shallower ponds resemble marshes on Earth, with knee- to ankle-level depths. Because equatorial lakes on Titan should evaporate over a period of just a few thousand years, the researchers argue that these ponds and lakes are being replenished by subsurface oases of liquid methane.</p> <p>Earth’s History in Fossil Raindrops</p> <p>For the first time, studies define a constraint on total atmospheric pressure for early Earth, and could dramatically improve climate models for this timeframe, changing researchers’ understanding of the planet at a time when life first arose. Researchers supported by the Exobiology element of the NASA Astrobiology Program have shown that fossil raindrop imprints constrained surface air density 2.7 billion years ago to less than twice modern levels. By studying the signatures of raindrops falling into volcanic ash, the researchers determined a relationship between the imprint size and raindrop impact momentum. Raindrop terminal velocity is dependent on air density, meaning that fossil raindrop imprints can provide direct information about the density of Earth’s early atmosphere.</p> <p>DNA Building Blocks Made in Space</p> <p>NASA researchers found evidence that nucleobases, DNA components essential to life, were likely created in space. The findings support the theory that meteorite and comet impacts may have delivered a “kit” of ready-made materials from space to the early Earth, assisting the origins of life on this planet. Researchers also found abiotically produced “nucleobase-analogs” in the meteorites; these are extremely rare on Earth. The precursor nucleobases are present in space and demonstrate a possible mechanism for nucleobase generation in space.</p>
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Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
PS-12-11: Demonstrate planned progress in understanding the origin and evolution of life on Earth and throughout the biosphere to determine if there is or ever has been life elsewhere in the universe. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.					
Contributing Theme:		Planetary Science			
Contributing Program(s):		Multiple Programs			
FY07	FY08	FY09	FY10	FY11	FY12
7SSE4	8PS04	9PS5	10PS07	PS-11-11	PS-12-11
Green	Green	Green	Green	Green	Green

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Planned Annual Performance	
FY13 Update	PS-13-8: Demonstrate planned progress in understanding the origin and evolution of life on Earth and throughout the biosphere to determine if there is or ever has been life elsewhere in the universe. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.
FY14	PS-14-8: Demonstrate planned progress in understanding the origin and evolution of life on Earth and throughout the biosphere to determine if there is or ever has been life elsewhere in the universe. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.

Reported Multi-Year Performance

Multi-Year Performance Goal 2.3.5.1: Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base. (In support of objective 2.3.5: "Identify and characterize small bodies and the properties of planetary environments that pose a threat to terrestrial life or exploration or provide potentially exploitable resources.")

FY11	NASA provides the skilled researchers and supporting planetary science knowledge base necessary for the Nation's scientific capabilities.
Green	
FY12	NASA Near Earth Asteroid Survey
Green	
	<p>NASA and its partners maintain a watch for near-Earth objects, asteroids, and comets that pass close to Earth as part of an on-going effort to discover, catalog, and characterize these potentially hazardous objects. This fiscal year, asteroid search teams funded by NASA's Near Earth Object Observation (NEOO) Program found another 21 asteroids larger than one kilometer in size with orbits coming within Earth's vicinity. Asteroid search teams also found one more near-Earth comet and 896 smaller asteroids of less than one kilometer in average diameter, bringing the total number known of all sizes to 9,118. The high precision orbit predictions computed by NASA's Jet Propulsion Laboratory show that none of these objects is likely to hit Earth in the next century. An object designated 2011 AG5 currently has the highest chance of Earth impact, currently computed at one in 500 on February 5, 2040. However, 1,330 (of which 154 are larger than 1 kilometer in diameter) are in orbits that could become a hazard in the more distant future and warrant continued monitoring.</p> <p>Detailed Characterization of Potentially Hazardous Asteroid</p> <p>During its November 2011 passage, researchers obtained physical properties of potentially hazardous asteroid 2005 YU55 from multiple observations made by Goldstone, Arecibo, the Very Long Baseline Array, and the Green Bank Telescope. Radar analysis led to accurate measurement of the asteroid's albedo and spin period, and revealed a number of structures on the surface of the asteroid. High-resolution images showed concavities, a ridge near the asteroid's equator, and numerous features interpreted as decameter-scale boulders. The number of boulders on the surface is comparable to that seen on the asteroid 25143 Itokawa by the Hayabusa spacecraft.</p> <p>Automated Potential NEA Destinations Assessment</p> <p>In a cooperative effort between the Goddard Space Flight Center's Navigation and Mission Design Branch and the Jet Propulsion Laboratory's NEO Program Office, a new capability was added to routine near-Earth asteroid (NEA) processing in March 2012 that assesses the accessibility for human and robotic spaceflight destinations for all NEAs as they are</p>

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	<p>discovered. The assessment data is continuously updated automatically and made available to researchers and mission designers via a new section on NASA's NEOO Program Web page "Accessible NEAs." The goal is to identify NEAs that may be good targets for both human and robotic exploration missions. Any interested party also may go online to subscribe to a mailing list to receive a daily email notification of updated results.</p> <p>The automated NEA accessibility assessment system monitors the space flight accessibility of the latest discoveries from the NEO search teams with up to date orbits and daily email notifications. The system continuously updates a comprehensive publically available database of potential human and robotic space flight targets and their round-trip mission opportunities. The Web site also displays upcoming opportunities to observe those NEAs using ground-based telescopes and radar. The database of NEAs potentially suitable for human space exploration will naturally continue to grow in the months and years to come as more and more NEAs are discovered and observed.</p>
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Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
PS-12-12: Demonstrate planned progress in identifying and characterizing small bodies and the properties of planetary environments that pose a threat to terrestrial life or exploration or provide potentially exploitable resources. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.					
Contributing Theme:		Planetary Science			
Contributing Program(s):		Multiple Programs			
FY07	FY08	FY09	FY10	FY11	FY12
7SSE8	8PS08	9PS9	10PS10	PS-11-12	PS-12-12
Green	Green	Green	Green	Green	Green

Planned Annual Performance	
FY13 Update	PS-13-9: Demonstrate planned progress in identifying and characterizing small bodies and the properties of planetary environments that pose a threat to terrestrial life or exploration or provide potentially exploitable resources. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.
FY14	PS-14-9: Demonstrate planned progress in identifying and characterizing small bodies and the properties of planetary environments that pose a threat to terrestrial life or exploration or provide potentially exploitable resources. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.

Reported Annual Performance	
No annual performance goal in FY12 or trended performance.	
Contributing Theme:	Planetary Science
Contributing Program(s):	Multiple Programs

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Planned Annual Performance	
FY13 Update	No annual performance goal in FY13.
FY14	PS-14-10: Conduct research into mitigation strategies utilizing observed characteristics and properties of those small bodies that pose a threat to terrestrial life.

Reported Multi-Year Performance

Multi-Year Performance Goal 2.3.5.2: Return data for selection of destinations in order to lower risk for human space exploration beyond low Earth orbit.

FY11	<p>The routine processing and listing of accessible NEAs on the NASA NEOO Program Web site identifies and lists future observing opportunities for ground-based assets. These observing opportunities are used to obtain physical characterization information that could determine whether or not a particular NEA is suitable as a potential human destination. Ground-based sensors can provide details concerning the size, configuration, rotation rate, and composition of the NEA to help NASA mission planners and planetary scientists select the best targets for future human spaceflight missions. These opportunities are listed for optical and radar assets, which are used by the worldwide planetary astronomy community to perform physical characterization observations of these potentially accessible NEAs.</p> <p>Several steps have been taken to aid the collection of physical characterization data on these potentially human accessible NEAs. Two presentations were held in 2012 to brief the international NEA observing community at the Lunar and Planetary Science Conference and the Division for Planetary Sciences Meeting about the new listing of accessible targets and their associated observing opportunities. Both of these meetings generated significant interest in these targets, and several observers expressed a desire to help NASA obtain physical characterization data on these potentially NEA destinations. Awareness of this new capability has led many observers to check routinely the list of accessible NEAs to plan and schedule telescope time for upcoming observation periods. In addition, daily emails of accessible NEAs are distributed and scanned for new discoveries, and if a promising target is immediately or soon-to-be observable, a request is sent out to the international observing community for physical characterization observations.</p> <p>The NEOO Program pursued additional risk reduction efforts in coordination with the Human Exploration and Operation Mission Directorate's Joint Robotic Precursor Activity:</p> <ul style="list-style-type: none"> • Increased resources for time on ground-based planetary radars at Goldstone, CA, and Arecibo, PR, which enables a five-fold increase in the number of NEAs observed and characterized for precise orbit, size, and rotation information. An upgrade to the Goldstone radar has increased the resolution that can be imaged down to four meters. • Performed extensive analyses to develop several design reference missions for NEA human exploration including identification of additional investments required (i.e., concepts of operations, vehicle sizing, advanced propulsion) to expand number of viable NEAs to explore. • Supported multiple analog field tests, such as Desert Research and Technology Studies (RATS) and NASA Extreme Environment Mission Operations (NEEMO), for NEA mission system and operational concept validation and began planning for near-term asteroid analog mission at the International Space Station. • Released a Request for Information from industry for design of an NEA detection instrument to be flown as a hosted secondary payload on geosynchronous satellites.
Green	
FY12	
Green	

PERFORMANCE REPORTING AND PLANNING

Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
PS-12-13: Demonstrate planned progress in characterizing potentially hazardous objects that are possible destinations for future human space exploration.					
Contributing Theme:		Planetary Science			
Contributing Program(s):		Multiple Programs			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	9AC16 Green	10AC17 Green	PS-11-13 Green	PS-12-13 Green
Planned Annual Performance					
FY13 Update	PS-13-10: Demonstrate planned progress in characterizing potentially hazardous objects that are possible destinations for future human space exploration.				
FY14	PS-14-11: Demonstrate planned progress in characterizing potentially hazardous objects that are possible destinations for future human space exploration.				

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OUTCOME 2.4: DISCOVER HOW THE UNIVERSE WORKS, EXPLORE HOW IT BEGAN AND EVOLVED, AND SEARCH FOR EARTH-LIKE PLANETS.

NASA's [Astrophysics Division](#) seeks to understand the birth of the universe, the extremes of space and time near black holes, and the dark energy that fills the entire universe. It is exploring the relationship between the smallest of subatomic particles and the vast expanse of the cosmos. Its missions reveal the diversity of planets and planetary system architectures in the Milky Way galaxy; pinpoint Earth-like, potentially life-supporting planets in other solar systems; and study stellar and planetary environments and what powers the most energetic galaxies. Astrophysics designs and launches space telescopes that work in conjunction with ground and airborne telescopes to exploit the full range of the electromagnetic spectrum to view the broad diversity of the objects in the universe.

NASA's Astrophysics missions have provided researchers with new ways of looking at the universe so that they can expand knowledge about cosmic origins and fundamental physics. The study of the universe benefits the Nation's scientific research community by focusing research and advanced technology developments on optics, sensors, guidance systems, and propulsion systems. Some of these new and improved technologies enable groundbreaking capabilities, which are then available to the civil and defense sectors.

Stunning images produced from Astrophysics' operating missions continue to inspire the public, revealing the beauty of the universe and the science behind those images. The striking images from these observatories also are educational tools to help spark student interest in science, technology, engineering, and mathematics and serve to prominently illustrate the role of the United States in scientific exploration. NASA provides the tools to translate the science for the classroom and other learning venues in ways that meet educator needs.

Providing National Scientific Capabilities for Astrophysics

NASA continues to develop the Nation's capabilities in support of this science objective by funding research and mission development performed by scientists and engineers at universities, research centers, private sector organizations, and NASA Centers. The vast majority of research awards also include funding for postdoctoral fellows, graduate students, and undergraduate students, thereby supporting the education and training of future scientists and engineers.

Programs and activities serving this goal in FY 2012 include:

- Basic technology development in detector systems and materials sciences;
- Postdoctoral and early career fellowships through the Einstein, Hubble, and Sagan Postdoctoral fellowships and the Roman Technology Early Career fellowships; and
- Presidential Early Career Award for Scientists and Engineers.

The establishment, operation, and maintenance of necessary facilities is critical to the Nation's scientific capabilities. In FY 2012, NASA provided:

- Operations centers for NASA's astrophysics spaceflight missions including the [Hubble Space Telescope](#), [Chandra X-ray Observatory](#), [Spitzer Space Telescope](#), [Fermi Gamma Ray Space](#)

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- [Telescope](#), [Kepler Space Telescope](#), and other missions;
- Technology development including high contrast imaging testbeds at the [Jet Propulsion Laboratory](#), X-ray mirror production facilities at the [Goddard Space Flight Center](#), and the [X-ray Calibration Facility](#) at the [Marshall Space Flight Center](#);
- Operation of data archives that capture all NASA astrophysics data and make it available to the science community and the public, including the [Barbara Mikulski Archive for Space Telescopes](#), the [High Energy Astrophysics Science Archive](#), and the [Infrared Science Archive](#); and
- Operation of the Nation’s scientific balloon facilities in Palestine, Texas, and McMurdo Base, Antarctica.

NASA requires that all funded research investigations publish their results in open, peer reviewed science literature, ensuring that data and knowledge are captured.

Each year, the Astrophysics Subcommittee of NASA’s external advisory Science Committee evaluates the progress made by NASA toward each science objective. In FY 2012, the subcommittee found that expectations had been fully met by research results, which included those discussed below.

Reported Multi-Year Performance

Multi-Year Performance Goal 2.4.1.1: Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base. (In support of objective 2.4.1: "Improve understanding of the origin and destiny of the universe, and the nature of black holes, dark energy, dark matter, and gravity.")

FY11	<p>NASA provides the skilled researchers and supporting astrophysics knowledge base necessary for the Nation’s scientific capabilities. . Efforts in support of this science objective include the Chandra X-ray Observatory, Hubble Space Telescope, Fermi Gamma Ray Space Telescope, Spitzer Space Telescope, Kepler Space Telescope, and other missions.</p> <p>El Gordo: NASA's Chandra Finds Largest Galaxy Cluster in Early Universe</p> <p>The largest galaxy cluster seen in the distant universe was found using NASA's Chandra X-ray Observatory and the National Science Foundation-funded Atacama Cosmology Telescope (ACT) in Chile.</p> <p>Officially known as ACT-CL J0102-4915, the galaxy cluster was nicknamed "El Gordo" ("the big one" or "the fat one" in Spanish) by the researchers who discovered it. This cluster is located more than seven billion light years from Earth. This large distance means that it is being observed at a young age. Galaxy clusters, the largest objects in the universe that are held together by gravity, form through the merger of smaller groups or sub-clusters of galaxies. Because the formation process depends on the amount of dark matter and dark energy in the universe, clusters can be used to study these mysterious phenomena. Thus, El Gordo will provide an important link for understanding the content of the universe, essential to establishing its origin and ultimate fate. (Read more about this story.)</p>
Green	
FY12	
Green	

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	<p>Giant Black Hole Kicked Out of Home Galaxy</p> <p>Astronomers have found strong evidence that a massive black hole is being ejected from its host galaxy at a speed of several million miles per hour. New observations from NASA's Chandra X-ray Observatory of the black hole, located in the middle of a galaxy about four billion light years away, suggest that it collided and merged with another black hole and received a powerful recoil kick from gravitational wave radiation. The kick occurs because more gravitational waves are being emitted in one direction. These new data support the idea that gravitational waves—ripples in the fabric of space first predicted by Albert Einstein but never detected directly—can exert an extremely powerful force, able to move a black hole with the mass of millions of Suns. Although likely to be rare, such ejections could mean that there are many giant black holes roaming undetected out in the vast spaces between galaxies. (Read more about this story.)</p> <p>Fermi Observations of Dwarf Galaxies Provide New Insights on Dark Matter</p> <p>There's more to the cosmos than meets the eye. About 80 percent of the matter in the universe is invisible to telescopes, yet its gravitational influence is manifest in the orbital speeds of stars around galaxies and in the motions of clusters of galaxies. Despite decades of effort, no one knows what this "dark matter" really is. WIMPs, or Weakly Interacting Massive Particles, represent a favored class of dark matter candidates. Some WIMPs may mutually annihilate when pairs of them interact, a process expected to produce gamma rays, the most energetic form of light.</p> <p>NASA's Fermi Gamma Ray Space Telescope recently provided new clues. Using a novel technique where data from individual galaxies are analyzed jointly to boost the signal, the Fermi team examined roughly two dozen dwarf galaxies known to orbit the Milky Way. No gamma-ray signal consistent with the annihilations expected from four different types of commonly considered WIMP particles was found. For the first time, the results show that WIMP candidates within a specific range of masses and interaction rates cannot be dark matter. (Read more about this story.)</p>
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Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
AS-12-1: Demonstrate planned progress in understanding the origin and destiny of the universe, and the nature of black holes, dark energy, dark matter, and gravity. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.					
Contributing Theme:		Astrophysics			
Contributing Program(s):		Multiple Programs			
FY07	FY08	FY09	FY10	FY11	FY12
7UNIV1	8AS01	9AS1	10AS01	AS-11-1	AS-12-1
Green	Green	Green	Green	Green	Green

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Planned Annual Performance	
FY13 Update	AS-13-1: Demonstrate planned progress in understanding the origin and destiny of the universe and the nature of black holes, dark energy, dark matter, and gravity. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.
FY14	AS-14-1: Demonstrate planned progress in understanding the origin and destiny of the universe and the nature of black holes, dark energy, dark matter, and gravity. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.

Reported Annual Performance					
No annual performance goal in FY12.					
Contributing Theme:		Astrophysics			
Contributing Program(s):		Physics of the Cosmos			
FY07	FY08	FY09	FY10	FY11	FY12
7UNIV2 Yellow	8AS02 Green	None	10AS04 Green	None	None

Planned Annual Performance	
FY13 Update	AS-13-2: Achieve mission success criteria for the Fermi Gamma-ray Space Telescope.
FY14	No annual performance goal in FY14.

Reported Annual Performance	
No annual performance goal in FY12 or trended performance.	
Contributing Theme:	Astrophysics
Contributing Program(s):	Physics of the Cosmos
Planned Annual Performance	
FY13 Update	No annual performance goal in FY13.
FY14	AS-14-2: Complete NuSTAR mission success criteria.

Reported Multi-Year Performance

Multi-Year Performance Goal 2.4.1.2: By 2015, launch at least one mission in support of objective 2.4.1.

FY11	The launch of satellites provides the data that is critical to meeting NASA's scientific objectives. NASA completed this performance goal this year by launching the Nuclear Spectroscopic Telescope Array (NuSTAR) on June 13, 2012. NuSTAR carries the first focusing telescopes to image the sky in the high-energy X-ray region of the electromagnetic spectrum. The result is an unmatched ability to study high-energy X-ray sources like black holes and super-dense dead stars. On September 12, NASA celebrated NuSTAR's first 100 days in operation.
Green	
FY12	
Green	

Update to Multi-Year Performance Goal	
FY13 Update	No performance goal in FY13.
FY14	No performance goal in FY14.

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Reported Annual Performance					
AS-12-2: Complete the Nuclear Spectroscopic Telescope Array (NuSTAR) Launch Readiness Review.					
Contributing Theme:		Astrophysics			
Contributing Program(s):		Astrophysics Explorer			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	10AS02 Green	AS-11-2 Green	AS-12-2 Green
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	No annual performance goal in FY14.				

Reported Multi-Year Performance

Multi-Year Performance Goal 2.4.2.1: Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base. (In support of objective 2.4.2: "Improve understanding of the many phenomena and processes associated with galaxy, stellar, and planetary system formation and evolution from the earliest epochs to today.")

FY11	NASA provides the skilled researchers and supporting astrophysics knowledge base necessary for the Nation's scientific capabilities. Efforts in support of this science objective include the Chandra X-ray Observatory , Hubble Space Telescope , Fermi Gamma Ray Space Telescope , Spitzer Space Telescope , Kepler Space Telescope , and other missions.
Green	
FY12	<p>NASA's Hubble Shows Milky Way is Destined for Head-On Collision</p> <p>NASA astronomers announced they can now predict with certainty the next major cosmic event to affect the Milky Way galaxy, Sun, and solar system: the titanic collision of the Milky Way galaxy with the neighboring Andromeda galaxy, predicted to happen four billion years from now. This finding was provided through painstaking NASA Hubble Space Telescope measurements of the motion of Andromeda. Also known as M31, Andromeda is now 2.5 million light years away but falling toward the Milky Way under the mutual pull of gravity between the two galaxies and the invisible dark matter that surrounds them both.</p> <p>Although the galaxies will plow into each other, stars inside each galaxy are so far apart relative to their sizes that they will not collide with each other during the encounter. However, the stars will be thrown into different orbits around the new galactic center. Simulations show that Earth's solar system will probably be tossed much farther from the galactic core than it is today.</p> <p>The universe is expanding and accelerating, but collisions between galaxies in close proximity to each other still happen because they are bound by the gravity of the dark matter surrounding them. The Hubble Space Telescope's deep views of the universe show such encounters between galaxies were more common in the past when the universe was smaller. (Read more about this story.)</p> <p>NASA's Spitzer Detects Comet Seeding Primordial Planet</p> <p>NASA's Spitzer Space Telescope has detected signs of cometary ices raining down on</p>
Green	

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	<p>primordial ‘planetessimals’ (budding planets) in an alien solar system. This happened in this solar system several billion years ago. During that period, comets and other icy objects that were flung in from the outer solar system pummeled the primordial inner planets, generated huge clouds of dust and ice, scarred rocky planets and moons, and seeded them with water and organics that may have helped kick-start life.</p> <p>Spitzer spotted a band of dust around nearby bright star, Eta Corvi, with the tell-tale signature of an obliterated giant comet. This is the first time that evidence for such a comet storm has been seen around another star. This dust band is close to Eta Corvi, where Earth-like worlds could exist, implying a collision took place between a planet and one or more comets. The Eta Corvi system is about a billion years old, which is about the right age for such an extraterrestrial hailstorm.</p> <p>Earth’s solar system has a similar region, known as the Kuiper Belt, where icy and rocky leftovers from planet formation linger. About four billion years ago, some 600 million years after the solar system formed, scientists think the Kuiper Belt was disturbed by a migration of the gas-giant planets Jupiter and Saturn. This jarring shift in the solar system's gravitational balance scattered the icy bodies in the Kuiper Belt, flinging the vast majority into interstellar space and producing cold dust in the belt. Some Kuiper Belt objects, however, were set on paths that crossed the orbits of the inner planets.</p> <p>The resulting bombardment of comets lasted until 3.8 billion years ago. Some of these comets struck Earth, or were incinerated in the atmosphere, and are thought to have deposited water and carbon on this planet. This period of impacts might have helped life form by delivering its crucial ingredients. (Read more about this story.)</p>
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Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
AS-12-3: Demonstrate planned progress in understanding the many phenomena and processes associated with galaxy, stellar, and planetary system formation and evolution from the earliest epochs to today. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.					
Contributing Theme:		Astrophysics			
Contributing Program(s):		Multiple Programs			
FY07	FY08	FY09	FY10	FY11	FY12
7UNIV6	8AS06	9AS6	10AS09	AS-11-3	AS-12-3
Green	Green	Green	Green	Green	Green

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Planned Annual Performance	
FY13 Update	AS-13-3: Demonstrate planned progress in understanding the many phenomena and processes associated with galaxy, stellar, and planetary system formation and evolution from the earliest epochs to today. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.
FY14	AS-14-3: Demonstrate planned progress in understanding the many phenomena and processes associated with galaxy, stellar, and planetary system formation and evolution from the earliest epochs to today. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.

Reported Multi-Year Performance

Multi-Year Performance Goal 2.4.2.2: Design and assemble the James Webb Space Telescope (JWST).

FY11	<p>During FY 2012, the JWST Program successfully tested two of four science instruments, the Fine Guidance Sensor (FGS) and the Mid-Infrared Instrument (MIRI), in cryogenic vacuum conditions and qualified them for spaceflight and subsequently delivered them to NASA's Goddard Space Flight Center. The program also successfully completed the following significant and technically challenging developments and tests:</p> <ul style="list-style-type: none"> • Cryogenic vacuum testing on all flight primary mirrors to confirm precision optical shape under cryogenic conditions; • Fabrication of the flight primary mirror backplane support structure, a very complex graphite-epoxy composite structure, to exacting shape necessary to hold the primary mirrors; • The telescope tower, also a precision composite structure; • Extensive modifications of the large vacuum Chamber A at the Johnson Space Center (JSC) to add, for the first time, cryogenic testing capabilities; and • Fabrication of the critical center of curvature optical assembly, a critical element of precision testing of the flight optical system in JSC's Chamber A.
Yellow	
FY12	
Green	

Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
JWST-12-1: Begin integration of James Webb Space Telescope (JWST) flight optics into Optical Telescope Element (OTE).					
Contributing Theme:		James Webb Space Telescope			
Contributing Program(s):		James Webb Space Telescope			
FY07	FY08	FY09	FY10	FY11	FY12
7UNIV4 Green	8AS04 Green	9AS4 Green	10AS06 Green	JWST-11-1 Green	JWST-12-1 White
Why this APG was not achieved:					
The JWST Program replanning process resulted in a schedule revision that changed the milestone reflected in the FY 2012 measure. In the final review of the updated performance plan, NASA inadvertently missed correcting this measure to reflect the replan. The JWST Program continues to be on-track to complete its revised plan.					

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Planned Annual Performance	
FY13 Update	JWST-13-1: Deliver James Webb Space Telescope Near Infrared Camera to Integrated Science Instrument Module (ISIM) Integration and Test.
FY14	JWST-14-1: Complete JWST Spacecraft Critical Design Review.
Comments	The JWST Program replan rearranged milestones in the schedule, moving some earlier and delaying others. The FY 2013 and FY 2014 APGs reflect the changed milestone schedule resulting from the JWST Program's replan. The JWST Program has rescheduled the integration of the flight optics into the Optical Telescope Element (see APG JWST-12-1) for a forthcoming fiscal year.

Reported Multi-Year Performance

Multi-Year Performance Goal 2.4.2.3: Develop and operate an airborne infrared astrophysics observatory.

FY11	NASA and the German Aerospace Center, Deutsches Zentrum für Luft- und Raumfahrt (DLR) , are developing the Stratospheric Observatory for Infrared Astronomy (SOFIA) , an airborne observatory that will complement the Hubble, Spitzer, and Herschel space telescopes. The plan is to demonstrate SOFIA's full operational capability in 2014. The SOFIA Program has begun science flights during development to test and upgrade the instruments as needed. During FY 2012, the SOFIA Program completed the Early Science campaign, which began in FY 2011, and resulted in more than two dozen peer-reviewed papers based on the science results. The team then began preparing for Cycle 1 science observations by completing system upgrades, including observatory upgrades, and announcing General Observer investigations (totaling about 200 community science hours) evaluated by U.S.- and German-chartered peer-reviewed panels. The program also selected both the second-generation instrument upgrade proposal and the first full class of Airborne Astronomy Ambassadors: 26 U.S. and six German educators chosen to participate in Cycle 1 flights as partners and astronomers as part of a larger education, outreach, and enrichment program.
Green	
FY12	
Green	

Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
AS-12-4: Initiate the Stratospheric Observatory for Infrared Astronomy (SOFIA) Segment 3 Aircraft modifications and upgrades.					
Contributing Theme:		Astrophysics			
Contributing Program(s):		Cosmic Origins			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	9AS5 Yellow	10AS07 Yellow	AS-11-4 Green	AS-12-4 Green
Planned Annual Performance					
FY13 Update	AS-13-4: Complete the Systems Requirement Review (SRR) for the initial second generation Stratospheric Observatory for Infrared Astronomy (SOFIA) instrument.				
FY14	AS-14-5: Conduct Stratospheric Observatory for Infrared Astronomy (SOFIA) science flights to provide a minimum of 330 research hours.				

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Reported Multi-Year Performance

Multi-Year Performance Goal 2.4.3.1: Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base. (In support of objective 2.4.3: "Generate a census of extra-solar planets and measure their properties.")

FY11	<p>NASA provides the skilled researchers and supporting astrophysics knowledge base necessary for the Nation’s scientific capabilities. Efforts in support of this science objective include the Chandra X-ray Observatory, Hubble Space Telescope, Fermi Gamma Ray Space Telescope, Spitzer Space Telescope, Kepler Space Telescope, and other missions.</p> <p>NASA's Kepler Mission Redefines the Population of Extra-solar Planets</p> <p>The Kepler mission made major strides this past year in its census of extra-solar planets. It identifies planet candidates by measuring dips in the brightness of more than 150,000 stars to search for planets crossing in front of, or transiting, their stars. The Kepler science team requires at least three transits to verify a signal as a planet candidate. Further analysis or ground-based observations are required to confirm discoveries of planets.</p> <p>Kepler's count of candidate planets increased by more than a thousand during FY 2012, and stood at over 2,300 as of December. The largest part of this increase arises from the greater number of small planets discovered: over 900 are smaller than twice Earth's diameter, and over 200 are Earth-sized. Kepler results to date show that Neptune-sized planets are much more common than Jupiter-sized ones, a result that must be accounted for by all future planet formation theories. More than 500 Kepler planet candidates to date are found in a multi-planet system, which is defined as two or more planets circling the same host star. Kepler's count of candidate multi-planet systems is so large that no other explanation can account for it: almost all Kepler multi-planet candidates must be true planets. (Read more about this story.)</p> <p>NASA's Kepler Discovers Superlative Exoplanets</p> <p>The Kepler mission has confirmed its first planet in the "habitable zone," the orbital region around a star where temperatures allow liquid water to exist on a planet’s surface. Ten additional planet candidates near Earth size have been found in habitable zones and are awaiting confirmation. Candidates require follow-up observations using other telescopes to verify that they are actual planets.</p> <p>The newly confirmed planet, Kepler-22b, at 600 light years distance, is the smallest yet found to orbit in the middle of the habitable zone of a star similar to the Sun. The planet is about 2.4 times the radius of Earth. While it is larger than Earth, its orbit of 290 days around a Sun-like star resembles that of Earth. The planet's host star belongs to the same class as the Sun, a “G-type,” although it is slightly smaller and cooler. Scientists do not yet know if Kepler-22b has a predominantly rocky, gaseous, or liquid composition, but its discovery is a step closer to finding Earth-like planets. (Read more about this story.)</p> <p>Using data from NASA’s Kepler mission, astronomers announced the discovery of three new double-star planet systems: Kepler-16, Kepler-34, and Kepler-35. These findings establish that such “two sun” planets are not rare exceptions, but may in fact be common, broadening the hunting ground for systems that could support life. All three new planets are gaseous and Saturn-sized. Kepler-16b orbits a Sun-like star and its red dwarf companion</p>
Green	
FY12	
Green	

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	star every 229 days, while the two stars orbit each other every 41 days. Kepler-34b orbits its two sun-like stars every 289 days, and the stars orbit one another every 28 days. Kepler-35b orbits its smaller and cooler host stars every 131 days, and the stellar pair orbit each other every 21 days. (Read more about Kepler 16b and Kepler 34 and 35).
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Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
AS-12-5: Demonstrate planned progress in generating a census of extra-solar planets and measuring their properties. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.					
Contributing Theme:		Astrophysics			
Contributing Program(s):		Multiple Programs			
FY07	FY08	FY09	FY10	FY11	FY12
7UNIV7 Green	8AS07 Green	9AS7 Green	10AS10 Green	AS-11-5 Green	AS-12-5 Green

Planned Annual Performance	
FY13 Update	AS-13-5: Demonstrate planned progress in generating a census of extra-solar planets and measuring their properties. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.
FY14	AS-14-6: Demonstrate planned progress in generating a census of extra-solar planets and measuring their properties. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.

Reported Annual Performance					
No annual performance goal in FY12.					
Contributing Theme:		Astrophysics			
Contributing Program(s):		Exoplanet Exploration			
FY07	FY08	FY09	FY10	FY11	FY12
7UNIV8 Green	8AS08 Green	9AS8 Green	None	None	None
Planned Annual Performance					
FY13 Update	AS-13-6: Achieve mission success criteria for the Kepler mission.				
FY14	No annual performance goal in FY14.				

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Strategic Goal 3: Create the innovative new space technologies for our exploration, science, and economic future.

OUTCOME 3.1: SPONSOR EARLY STAGE INNOVATION IN SPACE TECHNOLOGIES IN ORDER TO IMPROVE THE FUTURE CAPABILITIES OF NASA, OTHER GOVERNMENT AGENCIES, AND THE AEROSPACE INDUSTRY.

The [Space Technology Mission Directorate](#) (STMD) includes nine programs (formerly included in the Space Technology Program within the Office of the Chief Technologist), representing all levels of technology readiness from early stage innovations to mission-ready projects. By investing in high payoff, disruptive technology that industry cannot tackle today, STMD matures the technology required for NASA’s future missions in science and exploration while proving the capabilities and lowering the cost for other government agencies and commercial space activities. STMD considers early-stage innovation, low technology readiness level (TRL) technology, to be the foundation of the development process. Investment in low-TRL technology increases knowledge and capabilities in response to new questions and requirements, and it stimulates creative new solutions to the challenges faced by NASA and the larger aerospace community.

Investments in low-TRL projects, through partnerships with the public and private sectors, have historically benefited the Nation on a broad basis, generating new industries and spin-off applications and providing a cadre of new technology-savvy innovators to fuel the Nation’s high-tech economy.

Reported Multi-Year Performance

Multi-Year Performance Goal 3.1.1.1: Develop and advance space technologies that support NASA's science, exploration and discovery missions.

FY11	<p>NASA is on track to meet this performance goal as the Agency continues to develop and advance technologies that support its science, exploration, and discovery missions. During FY 2012, the Agency researched, studied, and developed concepts of space technologies—as documented in 110 reports and plans—through the following programs: the Space Technology Research Grants (STRG) Program, the NASA Innovative Advanced Concepts (NIAC) Program, and the Center Innovation Fund (CIF) Program.</p> <p>In August 2011, the STRG Program awarded 80 NASA Space Technology Research Fellowships. During FY 2012, the selected graduate students performed space technology research at their respective campuses and at NASA centers and nonprofit U.S. Research and Development laboratories. In August 2012, the STRG Program additionally selected 10 Early Career Faculty Researchers to conduct research in priority areas including extending and sustaining human activities beyond low Earth orbit, exploring the evolution of the solar system and potential for life elsewhere, and expanding understanding of Earth and the universe.</p>
Green	
FY12	
Green	

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	<p>The NIAC Program invests in concepts with the potential to transform future aerospace missions, enable new capabilities, or significantly alter and improve current approaches. During FY 2012, the NIAC Program made excellent progress with its 30 initial Phase I studies selected in FY 2011. In August 2012, NIAC selected 18 new NIAC Phase I awards, and 10 new Phase II awards, based on earlier Phase I studies, to conduct research in FY 2013.</p> <p>The CIF Program stimulates and encourages creativity and innovation within the NASA Centers. Through the CIF Program, Centers support low TRL initiatives that leverage Center talent and capability. During FY 2012, the CIF Program supported technology development at each of the 10 NASA Centers.</p>
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Update to Multi-Year Performance Goal	
FY13 Update	Develop and advance early stage space technologies that support NASA's science, exploration and discovery missions.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
ST-12-1: Research, study or develop concepts of 100 technologies as documented in technology reports or plans.					
Contributing Theme:		Space Technology			
Contributing Program(s):		Crosscutting Space Technology Development			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	ST-11-1 Green	ST-12-1 Green
Planned Annual Performance					
FY13 Update	ST-13-1: Research, study, or develop concepts for 120 technologies as documented in technology reports or plans.				
FY14	ST-14-1: Research, study, or develop concepts for 150 technologies as documented in technology reports or plans.				
Comments	Based on the FY 2012 actual of 110 technologies documented in technology reports and plans, exceeding the target of 100 technologies, NASA has increased the FY 2013 target from the original 100 technologies to 120 technologies. NASA anticipates an increase in the number of relevant plans and reports again in FY 2013.				

Reported Multi-Year Performance

Multi-Year Performance Goal 3.1.1.2: Provide cash prize incentives to non-traditional sources for innovations of interest and value to NASA and the Nation.

FY11 Green	<p>NASA is on track to meet this performance goal. Through the Centennial Challenges Program, the Agency provides cash prize incentives to non-traditional sources for innovations of interest and value to NASA and the Nation. For example, in FY 2012, NASA conducted the Sample Return Robot Challenge competition (June 15-18, 2012). Six teams competed to design, develop, and demonstrate the next generation of robots capable of autonomous exploration of the landscapes of other worlds. As no participating teams successfully met the rigorous performance requirements of the challenge, NASA will repeat the competition in 2013. The Centennial Challenges Program also has other challenge</p>
FY12 Green	

PERFORMANCE REPORTING AND PLANNING

	competitions in various stages of development and formulation.
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Update to Multi-Year Performance Goal	
FY13 Update	No performance goal in FY13.
FY14	No performance goal in FY14.
Comments	As of FY 2013, NASA has retired this performance goal.

Reported Annual Performance					
ST-12-2: Conduct at least one Centennial Challenges competition.					
Contributing Theme:		Space Technology			
Contributing Program(s):		Crosscutting Space Technology Development			
FY07	FY08	FY09	FY10	FY11	FY12
7ESRT3 Green	8IPP06 Green	None	None	ST-11-2 Green	ST-12-2 Green
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	No annual performance goal in FY14.				

Reported Multi-Year Performance

Multi-Year Performance Goal 3.1.1.4: Increase the proportion of Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) technologies successfully infused into NASA programs/projects.

FY11	NASA is on track to meet this performance goal. During FY 2012, the SBIR/STTR Programs continued to infuse technologies into NASA programs and projects. Specifically, the Agency has infused 29.1 percent (i.e., 232 of 797) of the SBIR/STTR Phase II technology projects awarded from 2005 through 2009.
Green	
FY12	
Green	

Update to Multi-Year Performance Goal	
FY13 Update	No performance goal in FY13.
FY14	No performance goal in FY14.
Comments	NASA has tracked the performance of the SBIR/STTR Programs technology infusion efforts through different measures for almost a decade. The SBIR/STTR Programs have always performed well, meeting or exceeding expectations. Based on this continual high performance, NASA is retiring this performance goal and its related APG. However, the Agency will continue to monitor the programs closely and report on metrics specified in the SBIR/STTR Reauthorization Act of 2011.

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Reported Annual Performance					
ST-12-4: At least 25 percent of the Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) Phase II technology projects awarded between 2005-2009 will be infused into NASA programs and projects.					
Contributing Theme:		Space Technology			
Contributing Program(s):		SBIR and STTR			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	10IPP07 Green	ST-11-4 Green	ST-12-4 Green
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	No annual performance goal in FY14.				

Reported Multi-Year Performance

Multi-Year Performance Goal 3.1.1.5: Increase the Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) Phase III contracts initiated or expanded.

FY11	NASA is on track to meet this performance goal. During FY 2012, the Agency advanced 78 SBIR/STTR technologies to Phase III. It is understood that products may need further development at the conclusion of the Phase II work. Phase III projects receive funding from sources other than the SBIR/STTR Program to continue product development.
Green	
FY12	
Green	

Update to Multi-Year Performance Goal	
FY13 Update	No performance goal in FY13.
FY14	No performance goal in FY14.
Comments	NASA has tracked the performance of the SBIR/STTR Programs technology infusion efforts through different measures for almost a decade. The SBIR/STTR Programs have always performed well, meeting or exceeding expectations. Based on this continual high performance, NASA is retiring this performance goal and its related APG. However, the Agency will continue to monitor the programs closely and report on metrics specified in the SBIR/STTR Reauthorization Act of 2011.

Reported Annual Performance					
ST-12-5: At least 20 of the Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) technologies will be advanced to Phase III (received non-SBIR/STTR funding).					
Contributing Theme:		Space Technology			
Contributing Program(s):		SBIR and STTR			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	10IPP04 Green	ST-11-5 Green	ST-12-5 Green

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Planned Annual Performance	
FY13 Update	No annual performance goal in FY13.
FY14	No annual performance goal in FY14.

PERFORMANCE REPORTING AND PLANNING

OUTCOME 3.2: INFUSE GAME CHANGING AND CROSSCUTTING TECHNOLOGIES THROUGHOUT THE NATION'S SPACE ENTERPRISE, TO TRANSFORM THE NATION'S SPACE MISSION CAPABILITIES.

For a sustainable set of affordable programs that achieve longer-term goals, NASA requires a faster, more aggressive strategy for creating and applying new technologies. Without a robust effort that matures technologies and establishes their feasibility, the ideas and transformational concepts developed at a low TRL may not materialize into benefits for future NASA missions or the Nation's economy.

[The Space Technology Mission Directorate](#) (STMD) bridges the gap between idea formulation and mission infusion to deliver improvements to future missions. STMD includes programs (formerly included in the Space Technology Program within the Office of the Chief Technologist) that focus on maturing mid-TRL technologies and proving the feasibility of advanced space concepts and technologies that may lead to entirely new approaches to space system design and operations, exploration, and scientific research. Through significant modeling, analysis, ground-based testing, and laboratory experimentation, STMD will mature technologies in preparation for potential system-level flight demonstrations within NASA itself or by other government agencies. Executing these challenging laboratory and spaceflight demonstrations requires creating technology projects with well-defined milestones and schedules, developing facilities, laboratories, and flight test opportunities, fabricating materials, hardware, and software, developing and integrating technologies, and conducting demonstrations.

Reported Multi-Year Performance

Multi-Year Performance Goal 3.2.1.1: Transition developed game changing technologies to the technology demonstration programs or directly to Mission Directorates for mission insertion, and/or for use by other U.S. space activities.

FY11	<p>NASA is on track to meet this performance goal. During FY 2012, The Game Changing Development (GCD) Program continued to develop game changing technologies to transition to other Mission Directorates. Examples of GCD technologies delivered to the Human Exploration and Operations Mission Directorate during FY 2012 (unless otherwise noted) include:</p> <ul style="list-style-type: none"> • A 125 Watt fuel cell for use on a rover test bed; • Autonomous systems software, including an advanced caution and warning software update, a vehicle system manager, and cryogenic loading operations software; • Human-robotic system components, including an anchoring end effector, grappling and dexterous arms, and hands-free extravehicular activity (EVA) jet pack concepts; • A Rapid Cycle Amine (RCA) swing bed (version 2.0) for advanced carbon dioxide removal for extravehicular mobility unit (EMU); and • A Variable Oxygen Regulator (VOR) for EMU to reduce crew fatigue and consumable usage (delivered during the first quarter of FY 2013). <p>NASA also continues to initiate game changing technology projects. Examples of projects initiated during FY 2012 include Clean Space, Barrier Infrared Detector (BIRD), and Woven Thermal Protection System (W-TPS).</p>
Green	
FY12	
Green	

PERFORMANCE REPORTING AND PLANNING

Update to Multi-Year Performance Goal	
FY13 Update	Develop and advance game-changing and cross-cutting space technologies that support NASA's science, exploration, and discovery missions.
FY14	This performance goal remains the same in FY14.
Comments	As of FY 2013, NASA is consolidating all of the APGs contributing to Outcome 3.2 under this performance goal. NASA has broadened the performance goal to reflect this wider scope of work.

Reported Annual Performance					
ST-12-7: Initiate three game changing technology projects.					
Contributing Theme:		Space Technology			
Contributing Program(s):		Crosscutting Space Technology Development			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	ST-11-7 Green	ST-12-7 Green
Planned Annual Performance					
FY13 Update	ST-13-2: Complete three feasibility studies, ground demonstrations, or laboratory experiments proving the technical feasibility of new space technologies.				
FY14	ST-14-2: Complete at least ten feasibility studies, ground demonstrations, or laboratory experiments proving the technical feasibility of new space technologies.				

Reported Annual Performance					
ST-12-9: Initiate at least one new small satellite mission that will demonstrate game changing or crosscutting technologies in space.					
Contributing Theme:		Space Technology			
Contributing Program(s):		Crosscutting Space Technology Development			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	None	ST-12-9 Green
Planned Annual Performance					
FY13 Update	ST-13-3: Implement at least one new small spacecraft mission that was selected in the previous fiscal year to demonstrate game-changing or cross-cutting technologies in space.				
FY14	ST-14-3: Launch at least one small spacecraft demonstration mission and begin implementing at least one new small spacecraft project to demonstrate game changing or crosscutting technologies in space.				
Comments	In the FY 2013 Performance Plan released with the FY 2013 Budget Estimates, NASA's goal for ST-13-3 was to "[i]mplement at least one new small satellite mission that was initiated in FY 2012 and demonstrate game changing or cross-cutting technologies in space." This language did not accurately reflect the intent of goal, so NASA has revised the text. NASA has clarified the measurement to be made.				

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Reported Annual Performance					
ST-12-10: Complete preliminary design of at least one system-level technology for flight or relevant environment demonstration.					
Contributing Theme:		Space Technology			
Contributing Program(s):		Crosscutting Space Technology Development			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	ST-11-10 Green	ST-12-10 Green
Planned Annual Performance					
FY13 Update	ST-13-4: Implement at least two Technology Demonstration Missions (TDM) technology development projects that were initiated in the previous two years.				
FY14	ST-14-4: Conduct testing and/or relevant environment demonstration of three Technology Demonstration Mission (TDM) technology development projects.				
Comments	In the FY 2013 Performance Plan released with the FY 2013 Budget Estimates, the target was to implement at least three Technology Demonstration Mission technology development projects. At the time this measure was written, NASA had not completed the solicitation for these missions. NASA has adjusted the measure to reflect the actual number of proposals selected.				

Reported Annual Performance					
ST-12-11: Select and fly technology payloads from NASA, other government agencies, industry, and academia using flight services procured from at least three commercial reusable suborbital or parabolic platform providers.					
Contributing Theme:		Space Technology			
Contributing Program(s):		Crosscutting Space Technology Development			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	ST-11-11 Green	ST-12-11 Green
Planned Annual Performance					
FY13 Update	ST-13-5: Select and fly technology payloads from NASA, other government agencies, industry, and academia using flight services procured from at least three different commercial reusable suborbital or parabolic platform providers.				
FY14	ST-14-5: Select and fly technology payloads from NASA, other government agencies, industry, and academia using flight services procured from at least four different commercial reusable suborbital or parabolic platform providers.				

Reported Multi-Year Performance

Multi-Year Performance Goal 3.2.3.1: Demonstrate small satellite capabilities with game changing and crosscutting potential for the government and commercial space sectors.

FY11	NASA, through the Small Spacecraft Technology (SST) Program , remains on track to demonstrate small satellite capabilities with game changing and crosscutting potential for the government and commercial space sectors in FY 2013. The PhoneSat project, initiated before FY 2012, is awaiting launch as a rideshare on the inaugural flight of the Orbital Science Corporation's Antares rocket currently scheduled for early 2013. This project will demonstrate operation of an extremely low-cost satellite using a commercially procured
Green	
FY12	
Green	

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	<p>mobile telephone as its control system. A total of three individual PhoneSats will be launched, one of them being a second-generation PhoneSat developed during FY 2012.</p> <p>During FY 2012, NASA also initiated a new satellite mission, the Edison Demonstration of Smallsat Networks (EDSN). The EDSN project will demonstrate the use of a distributed set of small satellites for coordinated scientific observations. It has completed its System Requirements Review.</p>
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Update to Multi-Year Performance Goal	
FY13 Update	No performance goal in FY13.
FY14	No performance goal in FY14.
Comments	As of FY 2013, NASA has retired the focused performance goals under Outcome 3.2 and consolidated the APGs, including new refocused APGs, under performance goal 3.2.1.1. This will streamline STMD's multi-year performance measurement.

Reported Multi-Year Performance

Multi-Year Performance Goal 3.2.4.1: Infuse game changing and crosscutting technologies into future NASA missions or into national space activities through flight or relevant environment demonstrations.

FY11	<p>NASA remains on track to meet this performance goal. In August 2012 for example, the MSL Entry, Descent, and Landing Instrument (MEDLI) Suite, a first-of-its-kind instrumentation system on the Mars Science Laboratory, measured the temperature and pressure on the spacecraft as it flew through the Martian atmosphere. MEDLI delivered unprecedented environmental data that will help NASA build more efficient robotic and crewed Mars landers in the future.</p> <p>Also during FY 2012, NASA's Technology Demonstration Missions (TDM) Program completed the Preliminary Design Review for the Solar Sail technology demonstration and the Formulation Review for the Low-Density Supersonic Decelerator. Additionally, the TDM Program has multiple projects successfully progressing through their life cycles toward demonstration and infusion.</p>
Green	
FY12	
Green	

Update to Multi-Year Performance Goal	
FY13 Update	No performance goal in FY13.
FY14	No performance goal in FY14.
Comments	As of FY 2013, NASA has retired the focused performance goals under Outcome 3.2 and consolidated the APGs, including new refocused APGs, under performance goal 3.2.1.1. This will streamline STMD's multi-year performance measurement.

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Reported Multi-Year Performance

Multi-Year Performance Goal 3.2.5.1: Perform sub-orbital, simulated zero-gravity and other space analog flight opportunities to develop and demonstrate emerging ideas and technologies.

FY11	NASA is on track to successfully meet this performance goal. During FY 2012, the Flight Opportunities (FO) Program flew payloads on flights procured from three commercial reusable platform providers: Masten (suborbital), UP Aerospace (suborbital), and ZeroG (parabolic). These payloads to develop and demonstrate emerging ideas and technologies included: the Guidance Embedded Navigator Integrator Environment (GENIE) payload (on Masten Xombie), the Suborbital Flight Environment Monitor (SFEM) payload (on Up Aerospace SL-6), and 19 technology payloads on ZeroG aircraft.
Green	
FY12	
Green	

Update to Multi-Year Performance Goal	
FY13 Update	No performance goal in FY13.
FY14	No performance goal in FY14.
Comments	As of FY 2013, NASA has retired the focused performance goals under Outcome 3.2 and consolidated the APGs, including new refocused APGs, under performance goal 3.2.1.1. This will streamline STMD's multi-year performance measurement.

OUTCOME 3.3: DEVELOP AND DEMONSTRATE THE CRITICAL TECHNOLOGIES THAT WILL MAKE NASA'S EXPLORATION, SCIENCE, AND DISCOVERY MISSIONS MORE AFFORDABLE AND MORE CAPABLE.

The purpose of mission-driven technology development is to meet unique near-term mission needs within technical, cost, and schedule goals. NASA is prioritizing the desired set of future technologies that will offer the most synergies and advancement of mission capabilities. The Agency is enabling advances and improved performance by furthering existing evolutionary technologies, as well as developing revolutionary new technologies. It also is balancing potential technology benefits with specific mission risks to establish the appropriate time frame to infuse each emerging technology.

Reported Multi-Year Performance

Multi-Year Performance Goal 3.3.1.1: Demonstrate robotic technologies that support in-space operations, scientific discovery, and work as assistants with the crew.

FY11	NASA is on track to meet this performance goal. During FY 2012, Robonaut 2 (R2) , a dexterous humanoid robot, successfully worked with three task panels onboard ISS (i.e., powered task panel, intravehicular activity task panel, and EVA task panel). These activities demonstrate the robot's ability to manipulate human interfaces used in space operations and scientific discovery. On the EVA task panel, for example, R2 performed handrail grasping and cleaning. Additionally, R2 demonstrated its ability to work with a handheld airflow measurement system onboard ISS and provided data to ground controllers during its first tool use demonstration.
None	
FY12	
Green	
	During FY 2012, NASA also completed and tested telerobotic software used to control and operate R2. The new software was formally validated in October 2012 in preparation for upload to ISS.

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Update to Multi-Year Performance Goal	
FY13 Update	Develop technologies to enable autonomous mission operations in space to increase affordability.
FY14	This performance goal remains the same in FY14.
Comments	NASA changed the description of this performance goal to reflect the broadened scope of work beginning in FY 2013.

Reported Annual Performance					
ERD-12-5: Develop telerobotic software for remote manipulation of Robonaut 2.					
Contributing Theme:		Exploration Research and Development			
Contributing Program(s):		Advanced Exploration Systems			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	ERD-11-7 Green	ERD-12-5 Green

Planned Annual Performance	
FY13 Update	No annual performance goal in FY13.
FY14	No annual performance goal in FY14.

Reported Annual Performance	
No annual performance goal in FY12 or trended performance.	
Contributing Theme:	Exploration Research and Development
Contributing Program(s):	Advanced Exploration Systems

Planned Annual Performance	
FY13 Update	ERD-13-3: Test docking and anchoring techniques for asteroid missions using a prototype crew excursion vehicle, the Multi-Mission Space Exploration Vehicle (MMSEV), moving on an air bearing floor.
FY14	No annual performance goal in FY14.

Reported Annual Performance	
No annual performance goal in FY12 or trended performance.	
Contributing Theme:	Exploration Research and Development
Contributing Program(s):	Advanced Exploration Systems

Planned Annual Performance	
FY13 Update	ERD-13-4: Assess the feasibility of a Multi-Purpose Logistics Module (MPLM) based habitation module to support human deep-space missions.
FY14	No annual performance goal in FY14.

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Reported Annual Performance	
No annual performance goal in FY12 or trended performance.	
Contributing Theme:	Exploration Research and Development
Contributing Program(s):	Advanced Exploration Systems
Planned Annual Performance	
FY13 Update	No annual performance goal in FY13.
FY14	ERD-14-4: Test Autonomous Mission Operations software for ISS to reduce crew's dependence on ground-based mission control.

Reported Multi-Year Performance

Multi-Year Performance Goal 3.3.2.1: Develop advanced spacesuits to improve the ability of astronauts to conduct extravehicular activity (EVA) operations in space including assembly and service of in-space systems and exploration of surfaces of the Moon, Mars, near-Earth objects (NEOs), and other small bodies.

FY11	Over the three-year timeframe for this performance goal and by the end of FY 2013, NASA will achieve the goal of assembly and test of the Portable Life Support System (PLSS). This is the system attached to the spacesuit that regulates pressure that provides breathable oxygen, removes excess moisture and odors, and provides other life support. NASA completed the PLSS design review and plans to test it in a vacuum chamber in FY 2013.
Green	
FY12	
Green	

Update to Multi-Year Performance Goal	
FY13 Update	Develop advanced spacesuits to improve the ability of astronauts to conduct Extra Vehicular Activities (EVA) for in-space operations and surface exploration.
FY14	No performance goal in FY14.
Comments	NASA's work on EVA systems is part of a wider effort to develop capabilities for crew mobility for the human exploration of near-Earth asteroids and planetary surfaces. In FY 2014, after current work on EVA systems is concluded, NASA will align any planned future technology development activities to the broadened performance goal 3.3.1.1.

Reported Annual Performance					
ERD-12-6: Complete tests of Extra Vehicular Activity (EVA) Portable Life Support System (PLSS) subsystem in a vacuum chamber environment.					
Contributing Theme:		Exploration Research and Development			
Contributing Program(s):		Advanced Exploration Systems			
FY07	FY08	FY09	FY10	FY11	FY12
None	8CS06 Yellow	None	None	ERD-11-8 Green	ERD-12-6 Yellow
Why this APG was not achieved:					
NASA rescheduled the test of the PLSS in a vacuum chamber to FY 2013 based on a realignment of funding to other priorities. Assembly of the device also was delayed due to component technology development timelines that were greater than anticipated.					

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Planned Annual Performance	
FY13 Update	ERD-13-5: Test a packaged Portable Life Support System (PLSS) for an advanced spacesuit in a vacuum chamber.
FY14	No annual performance goal in FY14.

Reported Multi-Year Performance

Multi-Year Performance Goal 3.3.2.2: Develop technologies and mission concepts for demonstrating in-space cryogenic propellant storage and transfer making exploration and science missions more affordable and capable.

FY11	NASA is on track to meet this performance goal. During FY 2012, the TDM Program completed the Mission Concept Review for the Cryogenic Propellant Storage and Transfer (CPST) demonstration. CPST also passed Key Decision Point-A in June 2012. This milestone indicates NASA's decision to proceed with the Concept and Technology Development phase of project formulation, culminating in a System Requirements Review.
Green	
FY12	
Green	

Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
ST-12-12: Complete the Mission Concept Review for the Cryogenic Propellant Storage and Transfer demonstration.					
Contributing Theme:		Space Technology			
Contributing Program(s):		Exploration Technology Development			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	ST-11-12 Green	ST-12-12 Green
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	ST-14-6: Complete the Mission Concept Review for the Cryogenic Propellant Storage and Transfer demonstration.				

Reported Multi-Year Performance

No Multi-Year Performance Goal in FY12 or trended performance.

Update to Multi-Year Performance Goal	
FY13	No performance goal in FY13.
FY14	3.3.2.3: Mature environmental control and life support system (ECLSS) technology that enables human exploration beyond low-Earth orbit and improves affordability.

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Reported Annual Performance	
No annual performance goal in FY12 or trended performance.	
Contributing Theme:	Exploration Research and Development
Contributing Program(s):	Advanced Exploration Systems
Planned Annual Performance	
FY13 Update	No annual performance goal in FY13.
FY14	ERD-14-5: Conduct integrated sub-system tests for improved water recovery and more reliable atmosphere revitalization systems.

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OUTCOME 3.4: FACILITATE THE TRANSFER OF NASA TECHNOLOGY AND ENGAGE IN PARTNERSHIPS WITH OTHER GOVERNMENT AGENCIES, INDUSTRY, AND INTERNATIONAL ENTITIES TO GENERATE U.S. COMMERCIAL ACTIVITY AND OTHER PUBLIC BENEFITS.

While technology and innovation are critical to accomplishing NASA's missions, it also benefits the U.S. economy through transfer of new technologies for other applications. NASA makes a determined effort to transfer technologies outside of the Agency and to develop technology partnerships. NASA's technology investments support advancement in key research areas, fuel rapid improvements in mission capabilities, foster a robust industrial base, improve the Nation's competitive position in the international marketplace, enable new industries, improve quality of life, and contribute to economic growth.

NASA seeks partnerships and cooperative activities with the emerging commercial space sector. Three key themes underscore this effort: considering the private sector as an investment partner and sharing the cost of developing a capability; purchasing services rather than hardware when possible; and fostering the creation of broader opportunities for innovation. Pursuing these partnership themes brings direct value to NASA's current and future missions, advances the interests of the partners, and encourages additional commercial space development. In addition to partnership strategies, NASA seeks to transfer its technologies directly to other government agencies, the national aerospace industry, and the broader U.S. commercial sector. NASA-spurred advances in energy, communication, health, materials science, and other fields generate spinoff applications that benefit the Nation. The Agency has established a core team at each Center charged with technology transfer, licensing, and new partnership development, and these teams work closely with scientists and engineers to match NASA technologies with the needs of external organizations.

Guided by [OCT](#), the [Innovative Partnerships Office](#) has a dual role: to seek partnerships that can leverage technologies, expertise, and capabilities to advance NASA's missions and to provide access to NASA resources including intellectual property that will benefit the United States through economic growth and improved quality of life. To achieve these two complementary objectives, NASA technology transfer professionals work closely with NASA Center scientists, engineers, and software developers to foster commercial application of NASA's wide spectrum of research and technology development. As noted in the annual NASA [Spinoff](#) publications, partnerships forged between NASA and others with shared vision and objectives have saved hundreds of lives, created thousands of jobs, provided millions of dollars in cost avoidance, and generated millions of dollars in revenue. More about the Agency's technology transfer activities also is available on [NASA's Open Government Initiative site](#).

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Reported Multi-Year Performance

Multi-Year Performance Goal 3.4.1.1: Establish 12 technology-related significant partnerships that create value for programs and projects. Track both quantitative dollar value and qualitative benefits to NASA (e.g., reduced volume or mass, improved safety) per year.

FY11	<p>NASA is on track to successfully meet this performance goal. During FY 2012, OCT developed a wide range of significant partnerships with both the public and private sectors. Some of the factors OCT uses to frame the definition of significance include impact, scope/size/funding, uniqueness of collaboration, strategic outcome, and/or value-added to NASA's capabilities. OCT completed the following 12 significant partnerships with:</p> <ul style="list-style-type: none"> • The City of New York to provide NASA independent verification and validation (IV&V) services to critical system software, provide analysis results and technical reports, participate in reviews and provide status reports, and produce a variety of deliverables concerning the Emergency Communications Transformation Program. In this partnership NASA will make services, data, and analysis available to New York City, in collaboration with NASA's IV&V Facility. • Cumberland and Western Company to develop a strategic technology and commercialization partnership anchored in state-of-the-art fly wheel technologies, which are useful in the design and production of revolutionary energy storage and energy transfer devices. • The University of Surry, United Kingdom, to establish cooperation between the Parties in the Deploytech Project, Work Package 1, for the advancement of the TRL of space deployable solar sail technology. • DTM Technologies, Modena, Italy, for access to reduced gravity testbeds under the NASA Flight Opportunities Program to advance the technology readiness level of a nano-particle migration and capture device to facilitate the commercial and government use of space-related technologies. • Nirvana Energy Systems to develop a Stirling Homepower Unit with a predicted efficiency of at least 32 percent. • The "E-Fermi" Advanced Technical Institute to study how reduced gravity conditions influence the sintering process. • National Institute of Standards and Technology (NIST) to collaborate with the Advanced Manufacturing National Program Office to advance manufacturing in the United States. • Honda R&D Americas to test an epoxy coating system using NASA's Smart Coating System technology to support mutual technology needs. • Sherwin Williams to determine the performance benefit of using a corrosion-induced microcapsule system to improve corrosion resistance of a coating over steel. • LifeLoc to investigate and characterize the technical feasibility and practicality of applying Glenn Research Center's sensor technologies and related expertise to commercialization of the miniaturization and operating temperature stability of precision fuel cell sensors and breath sampling system for commercial application in portable breath alcohol testers. • The Space Frontiers Foundation to collaborate on public events and to support a business plan competition with a \$100 thousand first-prize purse. This business plan competition specifically aims at generating economic development and broadening entrepreneurial space opportunities for public benefit. • The Manufacturing Advocacy and Growth Network (MAGNET) to create an on-going collaboration to interject NASA knowledge and expertise to the local public sector for the purpose of aiding the region's economic development, This agreement will provide MAGNET clients opportunities to interact with NASA subject matter experts and utilize NASA facilities to overcome technical barriers that prohibit their products from going to market. The collaboration will enhance the national economy while maintaining the U.S.
Green	
FY12	
Green	

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	leadership in technology.
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Update to Multi-Year Performance Goal	
FY13 Update	Accelerate the development and adoption of NASA-funded technology through the establishment of cost-sharing partnerships.
FY14	This performance goal remains the same in FY14.
Comments	NASA has revised this performance goal description to reflect the broadened scope of work.

Reported Annual Performance					
ST-12-13: Establish at least 12 technology-related significant partnerships during FY 2012.					
Contributing Theme:		Space Technology			
Contributing Program(s):		Partnership Development and Strategic Integration			
FY07	FY08	FY09	FY10	FY11	FY12
7IPP1 Green	8IPP01 Green	9IPP1 Green	None	ST-11-13 Green	ST-12-13 Green

Planned Annual Performance	
FY13 Update	ST-13-6: Establish a total of twelve partnerships with U.S. industry, other U.S. agencies, or other entities to develop technology that supports NASA's missions or national interests.
FY14	ST-14-7: To reduce the time it takes to process a NASA Space Act Agreement (SAA), initiate an NASA study and implement steps that result in a 10 percent reduction in time at least 5 NASA Centers in FY2014.
Comments	NASA establishes hundreds of partnerships each fiscal year. As a result, the Agency consistently achieves and exceeds its annual target to establish partnerships to develop technology. In FY 2014, NASA is changing the focus to improving performance Agency-wide for processing a specific type of partnership, for which there are performance challenges. The goal is to reduce the time it takes to process a Space Act Agreement and begin the associated study.

Reported Multi-Year Performance

Multi-Year Performance Goal 3.4.1.2: Complete 30 technology transfer agreements with the commercial and academic community through such mechanisms as licenses, software use agreements, facility use agreements, and Space Act Agreements per year.

FY11 Green	NASA is on track to successfully meet this performance goal with the completion of 56 technology transfer agreements during FY 2012. Specifically, NASA has achieved 21 technology patent licenses (additional licenses are being negotiated) and released 35 new software programs into the public domain, increasing its emphasis on open source software.
FY12 Green	

Update to Multi-Year Performance Goal	
FY13 Update	No performance goal in FY13.
FY14	Implement 5-year Strategic Plan to improve ability to transfer NASA-developed technologies.

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Comments	NASA retired this performance goal because technology transfer is being covered by OCT's Priority Goal, "Enable bold new missions and make new technologies available to government agencies and U.S. industry." NASA plans to complete this Priority Goal by the end of FY 2013. In FY 2014, NASA will renew this performance goal with a more long-term and broadly stated scope that continues the important work accomplished under the Priority Goal.
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Reported Annual Performance					
ST-12-14: Complete at least 30 technology transfer agreements during FY 2012.					
Contributing Theme:		Space Technology			
Contributing Program(s):		SBIR and STTR			
FY07	FY08	FY09	FY10	FY11	FY12
7IPP2 Green	8IPP02 Green	9IPP2 Green	None	ST-11-14 Green	ST-12-14 Green
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	ST-14-8: The Agency will develop and implement 2 innovative methods for technology licensing.				

Reported Multi-Year Performance

Multi-Year Performance Goal 3.4.1.5: Document, coordinate, and prioritize Agency-level technology strategic investments to ensure NASA has a balanced portfolio of both near-term NASA mission (pull) technologies and longer-term transformational (push) technologies that benefit both Agency programs and national needs.

FY11	<p>NASA is on track to meet this performance goal. NASA has documented the majority of its technology investments, and it has coordinated and drafted a prioritized Space Technology Strategic Investment Plan (SSTIP). The SSTIP is a comprehensive strategic plan that prioritizes space technologies essential to the pursuit of NASA's Mission. The SSTIP provides a focused approach to guide NASA's space technology investment over the next four years within the context of a 20-year horizon. It does so in strategic terms, not specifying funding. This plan began to take shape in 2010, when NASA developed the draft Space Technology Roadmaps, 14 plans for developing technologies in 14 essential space technology areas over the next 20 years. NASA then requested the National Research Council to review the Space Technology Roadmaps and provide recommendations for improvement.</p> <p>During FY 2012, OCT issued an Agency-wide data call to capture space technology investments across NASA. Mission directorates and offices incorporated project descriptions, technology readiness levels, technology areas, responsible parties, and partnerships into the NASA-developed and -managed Technology Portfolio System (TechPort). This new Agency internal Web site is now available to NASA civil servant and contractor employees. It can capture, track, and manage NASA's portfolio of technology investments, including detailed information on individual technology programs and projects. It enables NASA to efficiently search, identify technology gaps, update assessments of NASA's Roadmap Technology Areas, and provide comprehensive technology reports. It will be made available to the public in fall 2013.</p>
Green	
FY12	
Green	

PERFORMANCE REPORTING AND PLANNING

Update to Multi-Year Performance Goal	
FY13 Update	No performance goal in FY13.
FY14	No performance goal in FY14.
Comments	In FY 2012, OCT completed this performance goal by releasing the Space Technology Strategic Investment Plan and getting TechPort online. OCT is now implementing the plan and using TechPort to capture space technology investments across NASA.

Reported Annual Performance					
ST-12-17: Ensure that 75 percent of all NASA Space Technology Program's projects are recorded in the portfolio database.					
Contributing Theme:		Space Technology			
Contributing Program(s):		Partnership Development and Strategic Integration			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	None	ST-12-17 Green
Planned Annual Performance					
FY13 Update		No annual performance goal in FY13.			
FY14		No annual performance goal in FY14.			

Reported Multi-Year Performance

No Multi-Year Performance Goal in FY12 or trended performance.

Update to Multi-Year Performance Goal	
FY13	No performance goal in FY13.
FY14	3.4.1.6: Implement a process that enables the Agency to define and lead Agency Grand Challenges that impact life on Earth.

Reported Annual Performance	
No annual performance goal in FY12 or trended performance.	
Contributing Theme:	Space Technology
Contributing Program(s):	Partnership Development and Strategic Integration
Planned Annual Performance	
FY13 Update	
No annual performance goal in FY13.	
FY14	ST-14-9: Establish at least two new "open innovation" mechanisms that leverage external support for the Protect the Planet Grand Challenge.

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Strategic Goal 4: Advance aeronautics research for societal benefit.

OUTCOME 4.1: DEVELOP INNOVATIVE SOLUTIONS AND ADVANCED TECHNOLOGIES THROUGH A BALANCED RESEARCH PORTFOLIO TO IMPROVE CURRENT AND FUTURE AIR TRANSPORTATION.

NASA, through the [Aeronautics Research Mission Directorate \(ARM D\)](#), plays a key role in the discovery and development of the innovative solutions and advanced technologies required for the Next Generation Air Transportation System (NextGen). This includes pursuing technologies that are in their infancy today, developing the knowledge necessary to design radically new aviation systems, and enabling efficient, high-confidence design and development of revolutionary vehicles. These improvements must take place without compromise to the current safety record of the aviation industry.

ARM D's [Fundamental Aeronautics Program](#) takes an integrated approach to address the critical long-term challenges of NextGen. This program ensures a long-term focus on both traditional aeronautical disciplines and relevant emerging fields for integration into multidisciplinary system-level capabilities for broad application. The [Aviation Safety Program](#) develops innovative algorithms, tools, concepts, and technologies that will improve the safety attributes of current and future aircraft operating in the National Airspace System, identify and control emerging hazards, and overcome aircraft safety-related barriers that could impede full realization of NextGen. Finally, the [Airspace Systems Program](#) addresses the fundamental air traffic management research needs of increasing capacity, improving efficiency, and reducing the environmental impact of aviation in NextGen in collaboration with ARM D's partners in government, industry, and academia.

Reported Multi-Year Performance

Multi-Year Performance Goal 4.1.1.1: Transfer knowledge to the aviation community to better manage safety in aviation.

FY11	NASA developed and tested an analysis tool that can automatically review large-scale software systems for errors without needing to run the software. This capability is part of an on-going NASA research effort to reduce the time and cost associated with ensuring the safety of complex, flight-critical systems. NASA's tool reduced the analysis time from the three to four hours typical of a currently available commercial product down to several minutes. The NASA tool also achieved a false positive rate of five percent or less.
Green	
FY12	NASA also advanced its data mining algorithms that look for anomalous events occurring across thousands of flights that can represent precursors to aviation safety incidents. In a validation test, the latest algorithm successfully predicted the occurrence of known safety events with at least 10 percent more lead time than prior methods. Earlier recognition can be a good indicator of an algorithm's ability to reliably identify a wide range of potential safety concerns. These tests were done on real flight datasets of at least 10 terabytes. NASA provided the capabilities to the Federal Aviation Administration (FAA), the Aviation Safety
Green	

PERFORMANCE REPORTING AND PLANNING

	<p>Information Analysis and Sharing System (ASIAS), and multiple airlines.</p> <p>In addition, NASA completed a Concept of Operations for an Integrated Vehicle Health Assurance System. In this concept, NASA provides its research approach for monitoring the health of aircraft systems during in-flight and post-flight analyses and then using that knowledge to confidently predict system malfunctions before they occur. The concept integrates ground-based inspection and repair information with in-flight measurement data for airframe, propulsion, and avionics subsystems. This approach may eventually enable airline maintenance practices to rely more on the actual system health of an individual aircraft and less on fleet-wide reliability averages.</p> <p>Finally, NASA completed a first generation engine icing simulation code that predicts the adverse effects on engine performance due to high ice water content icing. Aircraft flying through high altitude thunderstorms encounter high concentrations of ice crystals. Under certain conditions, these ice crystals may cause ice to form inside a jet engine in a way that can degrade its performance, potentially leading to engine power loss. To better understand the hazards of high altitude icing, NASA modeled the conditions an engine would encounter throughout a hypothetical flight. NASA's model incorporated the effects of ice accumulation, melting, and sublimation (conversion from solid to gaseous state) into a basic jet engine performance computer simulation. A study used the model to estimate the risk of engine icing in ice crystal conditions and the effect of the blockage on engine performance. Results showed that ice particle size is an important factor affecting engine icing. The distribution of ice particle sizes in clouds is currently unknown and is of high interest to NASA and its U.S. and international partners. Working with partners, NASA is conducting studies that further explore the atmospheric conditions leading to ice crystal icing and the effects of that icing on engine performance. Results from these studies will help aircraft remain clear of hazardous icing conditions and make aircraft engines more resilient if those conditions do occur.</p> <p>For more information about NASA's Aviation Safety Program, go to http://www.aeronautics.nasa.gov/programs_avsafe.htm.</p>
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Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
AR-12-1: Develop first generation engine icing performance degradation parametric simulation capability.					
Contributing Theme:		Aeronautics			
Contributing Program(s):		Aviation Safety			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	None	AR-12-1 Green
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	AR-14-1: Conduct ground-based demonstration of a wireless sensor which provides lightning protection and can detect and diagnose damage in composite structures.				

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Comments	The next anticipated activity in this area was to conduct flight tests to characterize the ice crystal environment, which can adversely affect jet engine performance. This work was dependent on a contract that was discontinued due to unforeseen circumstances. As a result, NASA will not be able to complete a test flight in FY 2013 and has removed the associated FY 2013 APG from the performance plan. NASA and its partners are exploring opportunities for acquiring this important test data in the future.
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Reported Annual Performance					
AR-12-2: Provide static code analysis techniques for certification.					
Contributing Theme:		Aeronautics			
Contributing Program(s):		Aviation Safety			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	10AT01 Green	AR-11-1 Green	AR-12-2 Green
Planned Annual Performance					
FY13 Update	AR-13-2: Develop onboard capabilities that aid in-flight decision-making through instantaneous health assessment of aircraft systems.				
FY14	AR-14-2: Demonstrate use of an advanced software technique to verify the safety of a complex aircraft or ground automation software system.				

Reported Annual Performance					
AR-12-3: Develop concept of operations for an integrated vehicle health assurance system.					
Contributing Theme:		Aeronautics			
Contributing Program(s):		Aviation Safety			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	9AT4 Green	10AT04 Green	AR-11-2 Green	AR-12-3 Green
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	No annual performance goal in FY14.				

Reported Annual Performance					
AR-12-4: Demonstrate algorithm to predict at least three anomalies in massive datasets.					
Contributing Theme:		Aeronautics			
Contributing Program(s):		Aviation Safety			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	10AT01 Green	AR-11-1 Green	AR-12-4 Green
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	No annual performance goal in FY14.				

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Reported Annual Performance	
No annual performance goal in FY12 or trended performance.	
Contributing Theme:	Aeronautics
Contributing Program(s):	Aviation Safety
Planned Annual Performance	
FY13 Update	No annual performance goal in FY13.
FY14	AR-14-3: Provide integrated, high-fidelity simulator demonstration of an aerodynamic model that supports flight crew training requirements for assuring safe aircraft control.

Reported Multi-Year Performance

Multi-Year Performance Goal 4.1.2.1: HPPG: Increase efficiency and throughput of aircraft operations during arrival phase of flight.

FY11	<p>Results of NASA’s research to define and validate the Efficient Descent Advisor (EDA) concept were officially transferred in FY 2012 to FAA for further evaluation and potential operational use. The EDA concept helps air traffic controllers allow airliners of all sizes to more efficiently descend from cruising altitude to arrive at an airport using less engine power while maintaining a safe distance from other aircraft. As a result, airlines save money on fuel, fewer emissions are released into the atmosphere, and air traffic controller workload is reduced (since automation is added to the process). In fact, NASA simulations showed potential annual savings of \$300 million in fuel.</p> <p>NASA also successfully simulated airport operations using an integrated set of software that better manages scheduling and spacing of aircraft in congested terminal airspace. The technologies, which include Automatic Dependent Surveillance-Broadcast (ADS-B), a satellite based aircraft tracking technology, produced more precise aircraft spacing allowing for increased arrival rates and operational cost savings. The simulation was conducted with active FAA controllers, airline pilots, and data sets from Dallas/Fort Worth and Los Angeles airports. In addition, NASA successfully demonstrated safe interval management procedures to a single airport with dependent parallel runways utilizing NextGen flight-deck technologies. Benefits analysis indicates that these technologies have the potential to save several percent of total operational fuel costs due to more efficient arrivals. Although dependent on the level of aircraft equipment, annual system-wide savings are estimated at between \$200 million to \$300 million. Results from these simulations are being used to refine the plans for a future technology demonstration.</p> <p>In addition, NASA developed weather translation models that provided an estimate of the weather’s impact (e.g., high surface winds, low visibility, etc.) on an airport’s capacity for 1 to 8 hours in the future over a 15 minute interval. These models incorporated forecasts from three state-of-the-art, airport-centric weather forecasts from the National Weather Service. Two of the models on average were able to predict the weather-impacted Airport Arrival Rate (AAR) at two representative airports over a 1 to 8 hour look-ahead time horizon within 10-15 percent of the actual weather impacted AAR. The third model was able to estimate the weather impacted AAR over a one-hour look-ahead time horizon within five percent of the actual weather impacted AAR at three representative airports. This improvement in use of weather predictions will provide substantial increase in airport arrival throughput.</p>
Green	
FY12	
Green	

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	For more information about NASA's Airspace Systems Program, go to http://www.aeronautics.nasa.gov/programs_asp.htm .
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Update to Multi-Year Performance Goal	
FY13 Update	Demonstrate advanced technologies and solutions to achieve fuel efficient increases in operational performance of the Next Generation Air Transportation System (NextGen) while reducing noise and emissions.
FY14	Demonstrate advanced technologies and solutions to achieve fuel efficient increases in operational performance of the Next Generation Air Transportation System (NextGen) while reducing noise and emissions.
Comments	During FY 2012, NASA completed this Priority Goal and, with approval from the Office of Management and Budget, closed it out. Because ARMD is continuing work to increase operational performance of NextGen, NASA has retained 4.1.2.1 as a standard performance goal and revised the description to reflect current activities.

Reported Annual Performance					
AR-12-5: Develop Initial Weather Translation Models.					
Contributing Theme:		Aeronautics			
Contributing Program(s):		Airspace Systems			
FY07	FY08	FY09	FY10	FY11	FY12
7AT3 Green	8AT05 Green	9AT5 Green	10AT05 Green	AR-11-3 Green	AR-12-5 Green
Planned Annual Performance					
FY13 Update	AR-13-3: Conduct human-in-the-loop simulations for taxi operations conformance, which will reduce fuel consumption during movement on the airport surface.				
FY14	AR-14-4: Develop a scheduling tool to enable efficient aircraft departure and merging into open slots in the congested overhead traffic stream reducing departure delays.				

Reported Annual Performance					
AR-12-6: Demonstrate safe Interval Management Procedures to a Single Airport with dependent parallel runways.					
Contributing Theme:		Aeronautics			
Contributing Program(s):		Airspace Systems			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	10AT06 Green	AR-11-4 Green	AR-12-6 Green
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	No annual performance goal in FY14.				

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Reported Annual Performance					
AR-12-7: NASA will provide the results of the human-in-the-loop (HITL) simulations and the field trial to the Federal Aviation Administration (FAA) as they are completed, with the final report being provided in September 2012. (HPPG milestone)					
Contributing Theme:		Aeronautics			
Contributing Program(s):		Airspace Systems			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	10AT14 Green	AR-11-5 Green	AR-12-7 Green
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	No annual performance goal in FY14.				

Reported Multi-Year Performance

Multi-Year Performance Goal 4.1.3.1: Deliver tools, technologies, and knowledge that can be used to more efficiently and effectively design future air vehicles and their components to overcome national performance and capability challenges.

FY11	<p>NASA completed analyses of ground-based tests that characterized the emissions of hydro-treated renewable jet (HRJ) fuel, which is an alternative aviation fuel. The results showed that HRJ fuels and their blends had substantially reduced particulate emissions (characterized by small particles of solids and liquids), minor effects on gaseous emissions, and no measureable adverse effect on engine performance. These data are important to industry and other government agencies such as the FAA and Environmental Protection Agency (EPA) to help ensure that aircraft can safely and efficiently utilize alternative fuels.</p> <p>In order to realize significant improvements in efficiency and reductions in the environmental impact of aviation, it may be necessary to develop new aircraft designs that have little resemblance to today's tube-and-wing aircraft. NASA completed wind tunnel testing of a new concept that was very different from a tube-and-wing and demonstrated its reduced noise potential and improved short take-off and landing performance. Results from this test will be used to improve computational tools for a number of advanced aircraft configurations.</p> <p>NASA also made advances in making air travel even more flexible and convenient. It is highly desirable to make modern helicopters quieter and more efficient so that they can safely carry more people and cargo and be more effective in conducting current missions and new missions such as increased delivery and transportation. To support these improved capabilities, NASA made significant advances in rotary wing propulsion systems that included new types of engine compressors and new transmissions. Also, to make rotorcraft more efficient, NASA demonstrated advances in computational modeling for rotorcraft fuselage drag reduction systems. People are always looking to spend less time traveling and more time at their destination. One way to help achieve this desire is faster air transportation. Although the noise associated with sonic booms has always been a limiting factor, this may change due to NASA research. NASA successfully completed wind tunnel tests that validated the computational tools developed for designing and shaping supersonic aircraft to produce quieter sonic booms. As part of its efforts to understand how much sonic boom noise must be reduced to allow unrestricted overland flight, NASA conducted the first tests in a new facility for simulating sonic boom noise as heard indoors.</p>
FY12	

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	<p>The new computational design tools under development can greatly decrease the time needed for designing air vehicles and allow industry to explore new configurations. NASA completed the first generation of the Integrated Design and Engineering Analysis (IDEA) software, which enables the rapid and automated conceptual design of a hypersonic air-breathing vehicle. Because of this new tool, the time to conduct a vehicle design and analysis was reduced from 3 months (with today's methods) to less than 24 hours with the fully automated IDEA software tool. Another software tool was used to calculate the airflow through the scramjet engine of a hypersonic airbreathing vehicle, which was then compared with real flight data obtained from an Air Force flight. This comparison helps refine and improve the software, which is used to design scramjet engines.</p> <p>NASA studied hypersonic planetary physics by obtaining unique Martian atmospheric pressures, heat shield temperatures and heat shield recession data (loss of mass due to the ablation of the heat shield) from the instrumentation installed on the Mars Science Laboratory carrying the Curiosity rover. This highly unique data is being analyzed by researchers at NASA and universities in order to inform all future Mars landing missions to enable reduced vehicle mass or a larger, more capable scientific payload.</p> <p>For more information about NASA's Fundamental Aeronautics Program, go to http://www.aeronautics.nasa.gov/fap/index.html.</p>
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Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	Deliver tools, technologies, and knowledge that can be used to design future air vehicles and their components to overcome national challenges, especially in fuel efficiency, noise, and emissions.

Reported Annual Performance					
AR-12-8: Characterize gaseous and particulate emissions of hydro treated renewable jet fuel as a potential carbon dioxide (CO2) neutral aviation fuel.					
Contributing Theme:		Aeronautics			
Contributing Program(s):		Fundamental Aeronautics			
FY07	FY08	FY09	FY10	FY11	FY12
None	8AT07 Green	9AT7 Green	10AT07 Green	AR-11-6 Green	AR-12-8 Green
Planned Annual Performance					
FY13 Update	AR-13-4: Develop, improve, and validate a multi-fidelity toolset to assess the noise characteristics of future subsonic aircraft.				
FY14	AR-14-5: Determine the viability and performance benefits of a truss-braced-wing aircraft configuration through wind tunnel tests and high-fidelity computer simulations.				

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Reported Annual Performance					
AR-12-9: Demonstrate drag reduction benefits of active flow control for a representative rotorcraft fuselage configuration.					
Contributing Theme:		Aeronautics			
Contributing Program(s):		Fundamental Aeronautics			
FY07	FY08	FY09	FY10	FY11	FY12
7AT4 Green	8AT09 Green	9AT8 Green	10AT08 Green	AR-11-7 Green	AR-12-9 Green
Planned Annual Performance					
FY13 Update	AR-13-5: Validate high fidelity tools for sonic boom and drag prediction to enable the design of future supersonic air vehicles.				
FY14	AR-14-6: Demonstrate the noise reduction and performance benefits of active twist concepts for rotor control for rotary wing aircraft through wind tunnel testing.				

Reported Annual Performance					
AR-12-10: Validate the effectiveness of Micro-array Flow Control devices for improving performance and flow quality in low-boom supersonic propulsion inlets.					
Contributing Theme:		Aeronautics			
Contributing Program(s):		Fundamental Aeronautics			
FY07	FY08	FY09	FY10	FY11	FY12
None	8AT11 Yellow	9AT9 Green	10AT09 Green	AR-11-8 Green	AR-12-10 Green
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	No annual performance goal in FY14.				

Reported Annual Performance					
AR-12-11: Demonstrate First Generation Integrated Multi-Disciplinary Simulation Tool for Analysis and Design of Reusable Air-Breathing Launch Vehicles.					
Contributing Theme:		Aeronautics			
Contributing Program(s):		Fundamental Aeronautics			
FY07	FY08	FY09	FY10	FY11	FY12
None	8AT13 Green	9AT10 Yellow	10AT10 Yellow	AR-11-9 Yellow	AR-12-11 Green
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	No annual performance goal in FY14.				

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OUTCOME 4.2: CONDUCT SYSTEMS-LEVEL RESEARCH ON INNOVATIVE AND PROMISING AERONAUTICS CONCEPTS AND TECHNOLOGIES TO DEMONSTRATE INTEGRATED CAPABILITIES AND BENEFITS IN A RELEVANT FLIGHT AND/OR GROUND ENVIRONMENT.

As NextGen evolves to meet the projected growth in air traffic, researchers and technology developers must address the national challenges in the areas of mobility, capacity, safety, security, energy and the environment. In addition, researchers and technology developers must also address increasingly stringent aviation regulations, many of which are being imposed at the local levels. The [Integrated Systems Research Program \(ISRP\)](#) conducts research and technology development at an integrated system-level on promising aeronautical concepts and technologies and explores, assesses, and demonstrates their benefits in a relevant environment. By focusing on technologies that have already proven their merit at the fundamental research level, this program helps transition them more quickly to the aviation community, as well as inform future fundamental research needs. The integrated system-level research in this program is coordinated with on-going long-term, research within ARMD's three fundamental research programs, with the research being conducted in partnership with other government agencies and industry. In addition, the research will focus specifically on maturing and integrating technologies into major vehicle, ground and operational systems and subsystems for accelerated transition to practical application.

Currently the ISRP has two projects, the Environmentally Responsible Aviation (ERA) project and the Unmanned Aircraft Systems Integration in the National Airspace Systems (UAS/NAS) project. The ERA project is exploring and documenting the feasibility, benefits and technical risks of vehicle concepts and enabling technologies identified to have the potential to mitigate the impact of aviation on the environment. Throughout its existence, NASA has invested in technologies aimed at improving fuel efficiency and reducing noise and emissions of current and future aircraft. Many of these technologies have directly impacted the advancement of capability present in today's fleet, but are also applicable to the continued evolution of conventional configurations and to the realization of alternate airframe, propulsion and vehicle system concepts. The ERA project is currently developing promising vehicle configurations, airframe and propulsion concepts and technologies that were selected through aircraft system level assessments based on their potential to simultaneously reduce fuel burn, noise and emissions. These game-changing concepts and technologies will then be matured, and their performance will be evaluated at the sub-system and system level in relevant environments. The UAS/NAS project will contribute capabilities that reduce technical barriers related to the safety and operational challenges associated with enabling routine UAS access to the NAS. The desire and ability to fly Unmanned Aircraft Systems in the NAS is of increasing urgency. The application of unmanned aircraft to perform national security, defense, scientific, and emergency management is driving the critical need for less restrictive access by UAS to the NAS. This goal will be accomplished through a two-phased approach based on development of system-level integration of key concepts, technologies and/or procedures, and demonstrations of integrated capabilities in an operationally relevant environment. Solutions will advance the state of the art for UAS access. The timeframe for impact of this project will be 2015 to 2025. Each technical area will transfer technologies to relevant stakeholders, including the Federal Aviation Administration, Department of Defense (DoD), and industry, through research transition teams, technology forums, or other collaborative means.

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Reported Multi-Year Performance

Multi-Year Performance Goal 4.2.1.1: Reduce technical risk by conducting research at an integrated system-level on promising aeronautical concepts and technologies in a relevant environment.

FY11	<p>Throughout the initial phase (FY 2010–FY 2012) of the ERA project, a variety of tests and associated analyses were conducted with the goal of maturing promising technologies that will simultaneously reduce transport aircraft fuel burn, noise and emissions. Through these tests, environmentally friendly aircraft technologies were validated for performance and matured to the point that they can be tested together and in relevant environments. Through a series of reviews and assessments conducted in FY 2012, NASA selected eight, large-scale integrated technology demonstrations to advance ERA research based on the potential benefit of the technologies to meet project goals, and the associated costs and risks. The integrated technology demonstrations build on work performed during the initial phase of the project and will focus on five areas: aircraft drag reduction through innovative flow control concepts; weight reduction from advanced composite materials; fuel and noise reduction from advanced Ultra High Bypass (UHB) engines; emissions reduction from advanced engine combustors; and fuel consumption and community noise reduction through innovative airframe and engine integration designs. This integrated, relevant-environment testing is the focus of the second phase of the ERA project, which began in FY 2013.</p> <p>Based on data obtained during extensive ground test campaigns, NASA completed an assessment of two types of highly fuel-efficient jet engine concepts by comparing their performance in reducing the rate of fuel consumption and noise. One of the systems, referred to as “Open Rotor,” does not encase the engine fan blades in an engine housing as is typical in traditional jet engine designs. The second system, referred to as a “UHB Turbofan” is a much more fuel-efficient version of the aircraft engine commonly used by airliners today. Research has validated that both engine concepts have the potential to dramatically reduce fuel burn. The Open Rotor shows greater potential for fuel burn reduction (-36 percent vs. -27 percent) but at the price of a reduced noise reduction benefit when compared to the UHB concept (-13 dB vs. -24 dB). These results provide data to the aviation industry and regulatory community to make informed decisions on future aircraft propulsion systems, with a continual emphasis on reducing their impact on the environment.</p> <p>NASA also conducted final analysis of test data (in partnership with FAA and The Boeing Company) for a Pultruded Rod Stitched Efficient Unitized Structure (PRSEUS) curved panel, which successfully demonstrated the viability of this integrally stitched composite technology concept for conventional commercial aircraft fuselage structures. The excellent performance of this concept shows promise in enhancing the structural integrity of aircraft while reducing overall structural weight.</p> <p>As part of a collaborative effort with the FAA Technical Center, NASA conducted a flight test of a large (Ikhana MQ-9) unmanned aircraft equipped with ADS-B. This demonstration was a critical step in the development of a Live Virtual Constructive-Distributive Environment (LVC-DE), an innovative way to safely immerse a flying unmanned aircraft in the NAS through virtual techniques. The LVC-DE will provide the backbone for future flight tests (scheduled in FY 2015 and FY 2016) to validate the concepts and procedures developed by the project.</p> <p>In support of these flight tests, a comprehensive plan was developed that addresses, in an integrated manner, a number of the challenges vital for safe UAS operations in the NAS. This plan also outlined the specific test objectives and concepts of operations for the LVC-</p>
Green	
FY12	
Green	

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	<p>DE flight tests that will integrate remotely operated unmanned aircraft with simulated air traffic to evaluate these technologies in a relevant environment.</p> <p>For more information about NASA's Integrated Systems Research Program, go to http://www.aeronautics.nasa.gov/programs_isrp.htm.</p>
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Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
AR-12-12: Demonstrate low-weight, damage-tolerant stitched composite structural concept on curved panel subjected to combined tension and internal pressure loads.					
Contributing Theme:		Aeronautics			
Contributing Program(s):		Integrated Systems Research			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	10AT12 Yellow	AR-11-10 Green	AR-12-12 Green
Planned Annual Performance					
FY13 Update	AR-13-6: Conduct tests to validate low-noise characteristics of a hybrid wing body aircraft concept.				
FY14	AR-14-7: Demonstrate Ultra High Bypass (UHB) propulsion systems can be integrated with Hybrid Wing Body (HWB) concepts to meet fuel burn and noise goals.				

Reported Annual Performance					
AR-12-13: Develop integrated Human Systems Integration, Communications, and Separation Assurance subproject test concept and Phase 2 test objectives necessary to achieve human-in-the-loop simulation and flight test series milestones supporting the Unmanned Aircraft Systems (UAS) Integration in the National Airspace System (NAS) Project.					
Contributing Theme:		Aeronautics			
Contributing Program(s):		Integrated Systems Research			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	None	AR-12-13 Green
Planned Annual Performance					
FY13 Update	AR-13-7: Complete flight evaluations to assess the capabilities of the Live, Virtual, Constructive (LVC) distributed simulation environment.				
FY14	AR-14-8: Conduct a human-in-the-loop (HiTL) simulation where unmanned aircraft are mixed with manned aircraft and subjected to a range of test conditions.				

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Reported Annual Performance	
No annual performance goal in FY12 or trended performance.	
Contributing Theme:	Aeronautics
Contributing Program(s):	Integrated Systems Research
Planned Annual Performance	
FY13 Update	No annual performance goal in FY13.
FY14	AR-14-9: Conduct successful Project Formulation Review to enable the goal of accelerating the development and certification process for advanced composite structures thus improving the competitiveness of U.S. Industry.

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Strategic Goal 5: Enable program and institutional capabilities to conduct NASA's aeronautics and space activities.

OUTCOME 5.1: IDENTIFY, CULTIVATE, AND SUSTAIN A DIVERSE WORKFORCE AND INCLUSIVE WORK ENVIRONMENT THAT IS NEEDED TO CONDUCT NASA MISSIONS.

NASA has a skilled, competent, and dedicated workforce. They are passionate about their work, and they bring many dimensions of diversity, including ideas and approaches, to make their teams successful. To continue the successful conduct of missions over the next 10 to 30 years, NASA must broaden, maintain, and sustain its diverse workforce with the right balance of skills and talents. The [Office of Human Capital Management \(OHCM\)](#), [NASA Education](#), and the [Office of Diversity and Equal Opportunity \(ODEO\)](#) work collaboratively to identify future needs and to identify gaps and potential shortfalls in skills. They also cooperatively plan Agency-level participation in new employee recruitment efforts.

NASA established a Diversity and Inclusion Framework to increase the diversity of the workforce and the overall inclusiveness of the work environment. The framework takes the Agency beyond a focus on equal employment opportunity (EEO) compliance to policies and practices designed to enhance innovation, creativity, and employee engagement. Complementary to its diversity and inclusion efforts, the Agency works aggressively to identify and eliminate environmental factors that can diminish trust, impair teamwork, compromise safety, and ultimately undermine excellence. NASA conducts an annual self-evaluation as part of the Model EEO Plan, which is designed to identify and remove barriers to individual and team success.

NASA continues to make progress in its efforts to become a model agency for EEO. For example, NASA successfully continued to implement programs designed to prevent discrimination, such as conflict management, anti-harassment, and the provision of reasonable accommodations.

Reported Multi-Year Performance

Multi-Year Performance Goal 5.1.1.1: Define and build the workforce skills and competencies needed for the Agency's technology development and deep space exploration.

FY11	During FY 2012, OHCM made progress toward completing this performance goal, as described below:
Green	
FY12	Workforce Culture of Innovation <ul style="list-style-type: none"> • Developed and socialized a human capital framework designed to create a workforce culture that builds on innovation. • Introduced innovation as an organizing principle for human capital management work. OHCM built a portal page on innovation that highlights employee accomplishments and provides resources to employees. OHCM put innovation into practice by planning the first Virtual Executive Summit, held in October 2012. • Developed, deployed, and tested a workforce communication infrastructure to ensure that
Green	

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the Agency's workforce is well informed of major Agency initiatives and human capital programs, and executed several communications campaigns designed to enhance innovation and productivity. OHCM deployed a human resources messaging tool, HRMES, that enables the targeting of messages to particular groups.

- Designed and deployed the Work from Anywhere campaign to ensure that employees and supervisors know the many flexibilities available, including flexible work schedules.
- Developed, in concert with Agency leadership, an overarching, enhanced hiring program to refresh the Agency's talent pool. Key program components are implementation of the Pathways Program, the Federal student employment initiative, and an Agency recruitment program, which includes a fall recruitment opportunity in concert with the [Office of the Chief Engineer](#), and a winter invitational hiring event.
- Initiated a project to address the role of the NASA supervisor. The outcome of this project, which is led by several Center human resources directors, will influence all aspects of supervision, including selection, support, development, and accountability.
- In partnership with [ODEO](#), developed the Agency's Diversity and Inclusion Strategic Implementation Plan for submission to the [Office of Personnel Management \(OPM\)](#).
- Ranked first for innovation among Federal agencies by the [Partnership for Public Service](#) two years in a row.

Robust Policies, Programs, Processes, and Tools

- Continued to use the Agency Labor–Management Forum to build relationships and foster productive discussion of Agency issues.
- By labor and management working together, improved the performance management process for Government Schedule employees and developed process improvements to the current system, many of which will be implemented in 2012-2013. Development is underway to implement new OPM performance management guidelines for the Senior Executive Service. Piloted an automated performance management system, for full implementation in 2013-2014.
- Given very low attrition rates, created flexibility for Centers to address skill mix issues by extensive implementation of Voluntary Early Retirement Authority/Voluntary Separation Incentive Payments for FY 2012.
- Implemented a streamlined Agency honor awards process that provides more opportunities to award individuals for excellent work in a timelier manner.
- Led the Agency effort to develop the labor and workforce portion of the Agency budget submission for FY 2013 and FY 2014, providing options for workforce levels. Guided the Agency through GOLD implementation, a new process for managing FTE use. Implemented a revised, more consistent workforce planning process, including labor pricing.

Build Awareness Through Data and Dashboards

- Deployed executive dashboards with key performance indicators aligned with Agency goals, including a comprehensive workforce profile dashboard.
- Implemented an upgrade to SATERN, NASA's eLearning tool, including enhancements and improved capabilities to deliver online learning curriculum.
- Developed and delivered Agency and Center specific workforce reports to enable informed decision-making, including workforce planning and use reports and the State of the People, which provides useful workforce demographics and trends.

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Update to Multi-Year Performance Goal	
FY13 Update	Define and build diverse workforce skills and competencies needed for the Agency's technology development and deep space exploration.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
AMO-12-1: Sustain (from the previous fiscal year) NASA's Innovation Score, as measured by the Innovation-related questions of the Employee Viewpoint Survey (EVS), by taking actions such as refining and updating human capital policies, programs, and systems to support and encourage innovation to meet NASA's missions.					
Contributing Theme:		Agency Management and Operations			
Contributing Program(s):		Agency Management			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	10WF06 White	AMO-11-1 Yellow	AMO-12-1 Green

Planned Annual Performance	
FY13 Update	AMO-13-1: Sustain NASA's Innovation Score, as measured by the innovation-related questions in the Employee Viewpoint Survey (EVS), by taking actions like refining and updating human capital policies, programs, and systems to support and encourage innovation to meet NASA's missions.
FY14	AMO-14-1: Sustain (from the previous fiscal year) NASA's Innovation Score, as measured by the Innovation-related questions of the Employee Viewpoint Survey (EVS), by taking actions such as refining and updating human capital policies, programs, and systems to support and encourage innovation to meet NASA's missions.

Reported Multi-Year Performance

Multi-Year Performance Goal 5.1.1.5: Advance a workplace environment of equal opportunity, in which discrimination allegations, including harassing conduct and retaliation for equal employment opportunity (EEO) activity, are addressed promptly and effectively and in which reasonable accommodations are provided to individuals with disabilities.

FY11	NASA is making enormous strides in seeking to become a model Agency for EEO and is on target for attaining this performance goal. More specifically, NASA's efforts toward preventing discrimination—recognized as an essential element of achieving a model EEO agency by the U.S. Equal Opportunity Commission (EEOC) —have produced key benchmarks toward this goal:
Green	
FY12	<ul style="list-style-type: none"> • The Conflict Management Program (CMP), which provides managers and supervisors with the conflict resolution tools needed to reduce third-party intervention, such as the filing of EEO complaints or administrative grievances. OPM recognized CMP as an exemplary program for advancing equal opportunity. • The Agency's Anti-Harassment Program (AHP), which established a uniform, Agency-wide vehicle for addressing allegations of harassment promptly and effectively. EEOC recognized AHP as a highly effective means of addressing harassing conduct before it can reach the level of illegal discrimination.
Green	
	During FY 2012, ODEO undertook 11 actions—three more than planned—to address

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	<p>NASA’s EEO barriers as identified in the Agency's Model EEO Plan. They included the following:</p> <ul style="list-style-type: none"> • NASA completed an eLearning Tool on Disabilities; • An Agency-wide 508 Working Group continues to provide meaningful feedback to the Office of the Chief Information Officer on Section 508-related issues such as software workarounds; • Agency and Center Special Emphasis Program Managers are coordinating education and awareness events and initiatives; • ODEO provided feedback to the Agency Incentive Awards Board on its nomination process for Agency Honor Awards; • NASA's OHCM is implementing the Pathways Program, which is enhancing the Agency's recruitment strategies to reach a more broadly diverse talent pool; • ODEO and OHCM are also working on improvements to the Senior Executive Service (SES) and non-SES supervisory performance appraisal systems, particularly to include meaningful employment opportunity (EO) and diversity standards, and new language and weighting of the standards have been agreed upon; • ODEO and Center EO Offices continue to disseminate EO and diversity information, including displays, posters, newsletters, e-brochures, and other material to inform and educate the NASA workforce on EO matters; • Centers used student interns (two students per Center) with disabilities as part of Project ACCESS; • Centers continued to monitor and improve the accessibility of facilities for individuals with disabilities; • ODEO continued its EO Functional Review Program to ensure compliance of NASA Centers with EO laws and regulations; and • All NASA employees received an email encouraging them to update their race/ethnicity and disability status via Employee Express.
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Update to Multi-Year Performance Goal	
FY13 Update	Advance a workplace environment that affords Equal Employment Opportunities (EEO) to all employees and takes proactive diversity and inclusion efforts.
FY14	This performance goal remains the same in FY14.
Comments	NASA broadened this measure to include the activities from performance goal 5.1.1.6.

Reported Annual Performance					
AMO-12-7: Implement eight planned actions to address two identified potential employment barriers concerning individuals with disabilities, Asian/Pacific Islander, African American, Hispanic and female employees, based on the NASA Model Equal Employment Opportunity (EEO) Agency Plan.					
Contributing Theme:		Agency Management and Operations			
Contributing Program(s):		Agency Management			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	10WF01 Green	AMO-11-7 Yellow	AMO-12-7 Green

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Planned Annual Performance	
FY13 Update	AMO-13-2: Sustain five programs and processes designed to proactively prevent discrimination, as outlined in the Model EEO Agency Plan.
FY14	AMO-14-2: Access, evaluate, and report the success of the NASA Model EEO Agency Plan FY 11-13.

Reported Annual Performance					
AMO-12-8: Implement an Agency Diversity and Inclusion (D&I) Strategic Plan aligned with the Government-wide D&I Strategic Plan.					
Contributing Theme:		Agency Management and Operations			
Contributing Program(s):		Agency Management			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	10WF02 Green	AMO-11-8 Green	AMO-12-8 Green

Planned Annual Performance	
FY13 Update	AMO-13-3: Implement an Agency Diversity and Inclusion (D&I) Strategic Plan aligned with the Government-wide D&I Strategic Plan.
FY14	AMO-14-3: Evaluate overall progress and effectiveness of the Agency Diversity and Inclusion (D&I) Strategic Implementation Plan to date, in preparation for its completion in fiscal year 2015.

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Reported Multi-Year Performance

Multi-Year Performance Goal 5.1.1.6: Implement an Agency-wide Diversity and Inclusion Framework to develop a more demographically diverse workforce and a more inclusive work environment.

FY11	<p>Diversity and inclusion (D&I) are integral to NASA's mission success. NASA strives for an organizational culture and work environment with varying perspectives, education levels, skills, life experiences, and backgrounds in order to achieve excellence and realize individual and organizational potential. ODEO's D&I Strategic Framework and Strategic Implementation Plan provide a blueprint for fully leveraging diversity over the course of the next five years and beyond. As such, they offer innovative Agency guidelines and strategies designed to enhance the inclusiveness of NASA's work environments and to broaden the reach of NASA's education, recruitment, and small business efforts. The support and participation of everyone at NASA, including executive leadership, managers, supervisors, and employees, are critical components of successful implementation.</p> <p>Throughout FY 2012, NASA's implementation of its Agency D&I Plan continued to gain momentum. OPM approved the plan, recognizing it as comprehensive and NASA's leadership commitment to it as strong. OPM stated that, as a Federal agency, NASA is "well ahead of the curve" with its diversity planning. OPM also cited NASA for having a fully realized presence for D&I in the Agency's Strategic Plan and for the D&I Strategic Framework, specifically because the Strategic Framework is "inclusive of the full spectrum of senior leadership positions to better ensure diverse inputs into D&I decision-making and fully shared accountability, as well as to create sustainability through an institutionalized D&I structure."</p> <p>Plan implementation is currently focused on Agency-wide D&I communications and Center technical assistance. ODEO formed a senior-level D&I Communications Team to develop a comprehensive D&I Communications Plan for the Agency. The plan will inform and educate the workforce on D&I through consistent messaging and utilization of both traditional and nontraditional media. In addition, ODEO is spearheading a round of Center D&I technical assistance visits to assist Centers in standing up their own D&I initiatives. ODEO conducted visits at Stennis Space Center and Dryden Flight Research Facility during the fourth quarter of FY 2012.</p> <p>ODEO also is moving forward with other strategic D&I efforts, such as developing guidance on using employee resource groups to enhance D&I efforts at the local level, conducting Center briefings for the Agency's lesbian, gay, bisexual, and transgender communities on new NASA procedures for addressing sexual orientation discrimination complaints, and implementing the Pathways Program to broaden the diversity of the NASA pipeline and new hires.</p>
Green	
FY12	
Green	

Update to Multi-Year Performance Goal	
FY13 Update	No performance goal in FY13
FY14	No performance goal in FY14
Comments	NASA has completed this performance goal. In FY 2013, NASA has realigned the follow-on APGs to performance goal 5.1.1.5.

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Reported Multi-Year Performance

Multi-Year Performance Goal 5.1.2.1: Assure that student participants in NASA higher education projects are representative of the diversity of the Nation.

FY11	<p>NASA Education has consistently set aggressive diversity targets for student participation in its higher education projects for the underrepresented and underserved communities in STEM education. While the goal of 40 percent participation of underserved and underrepresented (in race and/or ethnicity) and 45 percent participation of women in NASA higher education projects are above the national averages earning degrees in STEM, NASA Education has and will continue to strive for success by setting ambitious targets. This year NASA did not meet its targets. In the coming years, Education will challenge itself even more by augmenting its tracking of this measure to include adding aggressive targets for participants with veteran status and disabilities. Additionally, targets may be tailored to the various programs to hold greater accountability on their managers. Education’s methodology is that, to improve annually and support this national need and Agency goal, it must set ambitious targets in hopes that when the national averages meet the diversity of the Nation, NASA would have been a leader in that effort and on par with the diversity levels of the Nation reflected in the Agency’s higher education participant community and workforce.</p> <p>The Office of Education took a closer look at its methodology for calculating participation by underserved and underrepresented communities and women. The resulting insights led to improved targets for FY 2013 and beyond. A full discussion of this review and next steps can be found in the performance improvement plan for Annual Performance Goals ED-12-1 and ED-12-2.</p>
Green	
FY12	
Yellow	

Update to Multi-Year Performance Goal	
FY13 Update	Assure that students participating in NASA higher education projects are representative of the diversity of the Nation, based on student enrollment data maintained by the U.S. Department of Education's National Center for Education Statistics.
FY14	This performance goal remains the same in FY14.

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Reported Annual Performance					
ED-12-1: Achieve 40 percent participation of underserved and underrepresented (in race and/or ethnicity) in NASA higher education projects.					
Contributing Theme:		Education			
Contributing Program(s):		STEM Education and Accountability			
FY07	FY08	FY09	FY10	FY11	FY12
7ED2 Green	8ED03 Green	9ED3 Red	10ED03 Yellow	ED-11-1 Yellow	ED-12-1 Red
Why this APG was not achieved: Out of the 15,585 participants in NASA higher education programs who reported their race and ethnicity, 24 percent reported being a member of an underserved or underrepresented race or ethnic group. NASA removed from the calculation the participants who did not report race or ethnicity. In an effort to better understand the percentage of all participants who may be from underserved or underrepresented populations, NASA also calculated the percentage of self-reported out of the total participants. Under this latter methodology, the participation is reduced to 21 percent. NASA estimates the actual percentage of underserved and underrepresented participants to be between these two figures. Additionally, NASA took a more holistic look across the Agency, where activities in the mission organizations may be encouraging participation, and factored this data. This reduced the overall percentage by one percent.					
Planned Annual Performance					
FY13 Update	ED-13-1: Provide significant, direct student awards in higher education to (1) racially or ethnically underrepresented students, (2) females, and (3) persons with disabilities at percentages that meet or exceed the national STEM enrollment percentages for these populations, as determined by the most recent publicly available data from the U.S. Department of Education's National Center for Education Statistics for a minimum of two of the three categories.				
FY14	ED-14-1: Provide significant, direct student awards in higher education to (1) racially or ethnically underrepresented students, (2) females, and (3) persons with disabilities at percentages that meet or exceed the national STEM enrollment percentages for these populations, as determined by the most recent publicly available data from the U.S. Department of Education's National Center for Education Statistics for a minimum of two of the three categories.				

Reported Annual Performance					
ED-12-2: Achieve 45 percent participation of women in NASA higher education projects.					
Contributing Theme:		Education			
Contributing Program(s):		STEM Education and Accountability			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	ED-11-2 Yellow	ED-12-2 Yellow
Why this APG was not achieved: Of the 17,454 participants in NASA higher education programs who reported their gender, 35 percent reported being female. NASA removed from the calculation the participants who did not report gender. In an effort to better understand the percentage of all participants who may be women, NASA also calculated the percentage of self-reported women out of the total participants. Under this latter methodology, the participation is reduced to 21 percent. NASA estimates the actual percentage of woman participants to be between these two figures. Additionally, NASA took a more holistic look across the Agency, where activities in the mission organizations may be encouraging participation, and factored this data. This made no appreciable difference to the overall percentage.					

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Planned Annual Performance	
FY13 Update	No annual performance goal in FY13.
FY14	No annual performance goal in FY14.

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OUTCOME 5.2: ENSURE VITAL ASSETS ARE READY, AVAILABLE, AND APPROPRIATELY SIZED TO CONDUCT NASA'S MISSIONS.

NASA’s assets are critical to mission success. NASA plans for, operates, and sustains the infrastructure that provides the programs and projects with the facilities, capabilities, tools, and services they require. Toward this end, NASA performs periodic Agency-level integrated assessments of the supply of technical capabilities across all Centers and integrated analyses of the demand for these capabilities across all programs. This provides NASA with core information needed to balance institutional supply with program and project demand, ensuring that capabilities are affordable and aligned with long-term strategic goals.

Several offices contribute to the achievement of this outcome. The [Office of Safety and Mission Assurance \(OSMA\)](#) and the [Office of the Chief Health and Medical Officer \(OCHMO\)](#) assure the safety and enhance the success of all NASA activities through the development, implementation, and oversight of Agency-wide safety, reliability, maintainability, and quality assurance policies and procedures. The [Office of the Chief Information Officer \(OCIO\)](#) delivers reliable, innovative, and secure information technology (IT) services critical to all aspects of the Agency’s operations. The [Office of Strategic Infrastructure](#) ensures that facilities and assets are appropriate and available to meet mission needs. This includes identifying assets and facilities that NASA no longer needs, maintaining and upgrading those in use, building or acquiring as needed, transitioning assets and facilities to new programs, and planning strategically for future needs.

Reported Multi-Year Performance

Multi-Year Performance Goal 5.2.1.1: Through 2015, assure the safety of NASA’s activities and reduce damage to assets through the development, implementation, and oversight of Agency-wide safety, reliability, maintainability, and quality assurance policies and procedures.

FY11	OSMA and OCHMO achieved all their goals in FY 2012, keeping them on track to ultimately achieve this performance goal. NASA maintained employee health and safety and, for the second year in a row, achieved total case rate and lost time case rate (based on work-related illness and injury claims submitted to Office of Workers Compensation Programs) far lower than the Federal average. Additionally, all of NASA’s FY 2012 launches were successful. Safety reviews conducted during mission development help assure that missions are ready for safe launch.
Green	
FY12	
Green	

Update to Multi-Year Performance Goal	
FY13 Update	Through 2015, assure the safety and health of NASA’s activities and reduce damage to assets through the development, implementation, and oversight of Agency-wide safety, reliability, maintainability, quality assurance and health and medical policies and procedures.
FY14	This performance goal remains the same in FY14.

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Reported Annual Performance					
AMO-12-9: Assure zero fatalities or permanent disabling injuries to the public resulting from NASA activities during FY 2012.					
Contributing Theme:		Agency Management and Operations			
Contributing Program(s):		Safety and Mission Success			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	10SMS01 Green	AMO-11-9 Green	AMO-12-9 Green
Planned Annual Performance					
FY13 Update	AMO-13-4: Assure zero fatalities or permanent disabling injuries to the public resulting from NASA activities during FY 2013.				
FY14	AMO-14-4: Assure zero fatalities or permanent disabling injuries to the public resulting from NASA activities during FY 2014.				

Reported Annual Performance					
AMO-12-10: Maintain a Total Case Rate and Lost Time Case Rate that meets the goals of the President's Protecting Our Workers and Ensuring Reemployment (POWER) initiative.					
Contributing Theme:		Agency Management and Operations			
Contributing Program(s):		Safety and Mission Success			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	AMO-11-10 Red	AMO-12-10 Green
Planned Annual Performance					
FY13 Update	AMO-13-5: Maintain a Total Case Rate and Lost Time Case Rate that meets the goals of the President's Protecting Our Workers and Ensuring Reemployment (POWER) initiative.				
FY14	AMO-14-5: For 2014, maintain a Total Case Rate and Lost Time Case Rate that meets the goals of the President's Protecting Our Workers and Ensuring Reemployment (POWER) initiative.				

Reported Annual Performance					
AMO-12-11: Reduce damage to NASA assets (excluding launched flight hardware) by two percent during FY 2012, based on a five-year running average (that also excludes launched flight hardware).					
Contributing Theme:		Agency Management and Operations			
Contributing Program(s):		Safety and Mission Success			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	AMO-11-11 Red	AMO-12-11 Green

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Planned Annual Performance	
FY13 Update	AMO-13-6: Reduce damage to NASA assets (excluding launched flight hardware) by two percent during FY 2013, based on a five-year running average (that also excludes launched flight hardware).
FY14	AMO-14-6: Reduce damage to NASA assets (excluding launched flight hardware) by two percent (using a five-year running average) during FY 2014, based on a two percent annual reduction from the FY 2010 baseline calculated using a five-year running average (that also excludes launched flight hardware).

Reported Multi-Year Performance

Multi-Year Performance Goal 5.2.2.1: By 2014, consolidate and centralize the management of information technology (IT) enterprise services for end user services, communications, and enterprise applications.

FY11	FY 2013 will see full implementation of all of NASA's IT Infrastructure Integration Program (I3P) services offices. The remaining initiative, Web Services, is fully funded and NASA will award the WESTPRIME contract in early 2013. The WESTPRIME contract will provide Infrastructure as a Service, Platform as a Service, and Software as a Service for both the internal and external NASA Web environment, including: <ul style="list-style-type: none"> • Provide Web services that meet the needs of NASA's diverse Web community; • Improve the current system, provide a technology refresh, and apply industry best practices; • Improve agility in adoption of tools and implementation of services; and • Provide diversity of options for users while managing cost and scope.
Green	
FY12	
Green	

Update to Multi-Year Performance Goal	
FY13 Update	By 2014, consolidate and centralize the management of information technology (IT) enterprise services for end user services, communications, and enterprise applications.
FY14	No performance goal in FY14.
Comments	NASA currently is assessing its IT measurement strategy and plans to revise its performance goals during the development of the 2014 Strategic Plan. In preparation, NASA is retiring this performance goal. When the assessment is completed, NASA will provide revised metrics for FY 2014.

Reported Annual Performance						
AMO-12-12: Achieve full operational capability (FOC) for three service offices as part of the NASA Information Technology Infrastructure Integration Program (I3P).						
Contributing Theme:		Agency Management and Operations				
Contributing Program(s):		Agency IT Services (AITS)				
FY07	FY08	FY09	FY10	FY11	FY12	
None	None	None	10IT02 Green	AMO-11-12 Yellow	AMO-12-12 Green	
Planned Annual Performance						
FY13 Update	AMO-13-7: Achieve full operational capability (FOC) on the remaining service office that is part of the NASA Information Technology Infrastructure Integration Program (I3P).					
FY14	No annual performance goal in FY14.					

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Reported Multi-Year Performance

Multi-Year Performance Goal 5.2.2.2: By 2015, implement a capability to identify and prevent unauthorized intrusions on the NASA institutional and mission networks.

FY11	During the fourth quarter of FY 2012, the Security Operations Center (SOC), located at the Ames Research Center, procured all equipment necessary to implement intrusion detection sensors, monitored by SOC, on 75 percent of NASA institutional network monitoring sights. SOC will install the equipment and bring it into operation before the end of the first quarter of FY 2013. This activity supports part of the Agency Cyber Security Strategic Plan for fiscal years 2012 through 2016.
Green	
FY12	
Green	

Update to Multi-Year Performance Goal	
FY13 Update	No performance goal in FY13.
FY14	No performance goal in FY14.
Comments	NASA currently is assessing its IT measurement strategy and plans to revise its performance goals during the development of the 2014 Strategic Plan. In preparation, NASA is retiring this performance goal. When the assessment is completed, NASA will provide revised metrics for FY 2014.

Reported Annual Performance					
AMO-12-13: Implement intrusion detection sensors monitored by the NASA Security Operations Center (SOC) on 75 percent of NASA institutional network monitoring sites.					
Contributing Theme:		Agency Management and Operations			
Contributing Program(s):		Agency IT Services (AITS)			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	10IT06 Red	AMO-11-13 Green	AMO-12-13 Green
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	No annual performance goal in FY14.				

Reported Multi-Year Performance

Multi-Year Performance Goal 5.2.2.3: By 2014, decommission the Agency Administrative mainframe computer.

FY11	OCIO completed decommissioning the mainframe computer on January 1, 2012.
Green	
FY12	
Green	

Update to Multi-Year Performance Goal	
FY13 Update	No performance goal in FY13.
FY14	No performance goal in FY14.

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Comments	OCIO has completed the work within this performance goal and, therefore, NASA is retiring this performance goal.
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Reported Annual Performance					
AMO-12-14: Migrate or retire all administrative systems from the Agency Administrative mainframe computer.					
Contributing Theme:		Agency Management and Operations			
Contributing Program(s):		Agency IT Services (AITS)			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	AMO-11-14 Green	AMO-12-14 Green
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	No annual performance goal in FY14.				

Reported Multi-Year Performance

Multi-Year Performance Goal 5.2.2.4: By 2015, reduce data center energy consumption by 30 percent.

FY11	NASA continued to meter all of the Agency's data centers to allow measurement of energy consumption and the subsequent effects of any improvements. NASA's models estimate that a reduction of approximately three percent has been realized to date, based on the closure of data centers. Congruent with data center closures, other activities were planned to contribute to energy savings: facility upgrades and improvement; replacement of old inefficient mechanical and IT equipment; and virtualizing underutilized IT infrastructure. Based on current plans, in the fiscally constrained environment, these latter activities will not be completed in a timeframe to achieve the targeted energy reduction.
Green	
FY12	
Yellow	

Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.
Comments	NASA currently is assessing its IT measurement strategy and plans to revise its performance goals during the development of the 2014 Strategic Plan. In preparation, NASA is retiring this performance goal. When the assessment is completed, NASA will provide revised metrics for FY 2014.

Reported Annual Performance					
AMO-12-15: Reduce the number of NASA data centers by 10 percent.					
Contributing Theme:		Agency Management and Operations			
Contributing Program(s):		Agency IT Services (AITS)			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	AMO-11-15 Green	AMO-12-15 Green

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Planned Annual Performance	
FY13 Update	AMO-13-8: Implement power metering in 100 percent of NASA data centers.
FY14	AMO-14-7: Maintain schedule of data center consolidations contained in NASA Federal Data Center Consolidation Plan.

Reported Multi-Year Performance

Multi-Year Performance Goal 5.2.2.5: Promote knowledge sharing and collaboration by effectively communicating IT Labs initiatives, projects and resources for information technology (IT) across NASA in support of the Agency's Mission.

FY11	IT Labs held its first annual Project Call in May 2012. Working with the OCIO Communication Office, the Technology and Innovation Program solicited project proposals from across the Agency. Thirty-six proposals were submitted Agency-wide and assessed by a diverse group of reviewers, including the Center Chief Technology Officers–ITs, OCIO Service Executives, and Mission Partners. Based on reviewer feedback and an overall assessment of the IT Labs portfolio, the program selected 16 research projects for funding. The program presented the close out briefing to the Baseline Performance Review on September 20, 2012, and on November 28, 2012, the program was selected as the Federal IT Program of the Year at the first annual FedScoop 50 Awards . This performance goal is now completed.
Green	
FY12	
Green	

Update to Multi-Year Performance Goal	
FY13 Update	No performance goal in FY13.
FY14	No performance goal in FY14.
Comments	NASA currently is assessing its IT measurement strategy and plans to revise its performance goals during the development of the 2014 Strategic Plan. In preparation, NASA is retiring this performance goal. When the assessment is completed, NASA will provide revised metrics for FY 2014.

Reported Annual Performance					
AMO-12-16: Identify innovative information technologies and create active participation opportunities for NASA scientists and engineers to collaborate on missions.					
Contributing Theme:		Agency Management and Operations			
Contributing Program(s):		Agency IT Services (AITS)			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	AMO-11-16 Green	AMO-12-16 Green
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	No annual performance goal in FY14.				

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Reported Multi-Year Performance

Multi-Year Performance Goal 5.2.3.1: Consolidate functions and offices to reduce real property need, and use Agency Integrated Master Plan to identify and dispose of excess and aged facilities beyond useful life.

FY11	<p>In FY 2012, NASA was on track to achieve this performance goal and completed both annual performance goals. The Office of Strategic Infrastructure will continue to work with the institution and the mission directorates to identify opportunities to reduce real property and dispose of excess and aged facilities.</p> <p>NASA began demolition activities for five facilities that are inactive or obsolete and no longer required for NASA's Mission. This is part of the Agency's effort to reduce operating costs and eliminate inactive and obsolete facilities. Abandoned facilities pose a potential safety and environmental liability. These abandoned facilities must be maintained at minimal levels to prevent increased safety and environmental hazards, imposing a drain on limited maintenance dollars. By demolishing these abandoned facilities, the Agency avoids non-productive operating costs associated with the maintenance.</p> <p>NASA identifies potential facilities for the demolition program through periodic studies to determine if a facility is required for current or future missions. NASA includes facilities that are no longer needed in a five-year demolition plan that sets project schedules based on last need, annual costs avoided, potential liability, and project execution factors. NASA sometimes adjusts individual project schedules in response to factors such as consultation with states on historic properties, changes in operational schedules, environmental remediation, funding profiles, local market forces, and cost of recycled materials.</p>
None	
FY12	
Green	

Update to Multi-Year Performance Goal	
FY13 Update	Between 2012 and 2016, eliminate obsolete and unneeded facilities and support the elimination of facilities that will not be needed after Space Shuttle retirement.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance						
AMO-12-17: Finalize remaining Center Master Plans into the Agency Integrated Master Plan.						
Contributing Theme:		Agency Management and Operations				
Contributing Program(s):		Agency Management				
FY07	FY08	FY09	FY10	FY11	FY12	
None	None	None	10FAC01 Green	AMO-11-17 Green	AMO-12-17 Green	
Planned Annual Performance						
FY13 Update	No annual performance goal in FY13.					
FY14	No annual performance goal in FY14.					

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Reported Annual Performance					
COF-12-1: Initiate facilities demolition process for five significant Agency facilities in addition to demolition processes initiated in FY 2011.					
Contributing Theme:		Construction of Facilities			
Contributing Program(s):		Institutional CoF			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	COF-11-1 Green	COF-12-1 Green
Planned Annual Performance					
FY13 Update	COF-13-1: Initiate the demolition or disposal of five facilities or structures during 2013 to reduce the Agency's footprint.				
FY14	COF-14-1: Initiate the demolition or disposal of five facilities or structures during 2014 to reduce the Agency's footprint.				

Reported Multi-Year Performance

No Multi-Year Performance Goal in FY12 or trended performance.

Update to Multi-Year Performance Goal	
FY13	5.2.4.1: Achieve savings for the Agency through acquisition reforms.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance	
No annual performance goal in FY12 or trended performance.	
Contributing Theme:	Agency Management and Operations
Contributing Program(s):	Agency Management
Planned Annual Performance	
FY13 Update	AMO-13-9: Achieve savings in contract costs of \$10 million in FY 2013, using FY 2012 as the baseline from which to measure savings.
FY14	AMO-14-8: Achieve savings in contract costs of \$10 million in FY 2014, using FY 2012 as the baseline from which to measure savings.

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OUTCOME 5.3: ENSURE THE AVAILABILITY TO THE NATION OF NASA-OWNED STRATEGICALLY IMPORTANT TEST CAPABILITIES.

NASA is responsible for stewardship of space and aeronautical laboratory systems, facilities, core competencies, and engineering and research capabilities. The [Rocket Propulsion Test \(RPT\) Program](#) within the [Human Exploration and Operations \(HEO\) Mission Directorate](#), the [Aeronautics Test Program \(ATP\)](#) within the [Aeronautics Research Mission Directorate](#), and the [Strategic Capabilities Assets Program \(SCAP\)](#) within the [Office of Strategic Infrastructure](#) ensure that these assets and capabilities are available to serve current and future needs of the Agency and the Nation. Assets and facilities managed and maintained by these programs—many of which are unique within the United States—are available to other government agencies and the commercial sector for developing and testing their technologies.

RPT optimizes use of NASA’s rocket propulsion test assets for efficiency and cost effectiveness and ensures that a minimum core capability for all aspects of rocket propulsion testing is maintained. These capabilities are critical to ensuring the Nation’s access to space by: providing engine, component, systems and anomaly testing; encouraging the pursuit of partnerships with the emerging commercial space sector; supporting Agency programs relative to the utilization of RPT resources; and investing in test technology and maintenance strategies.

ATP corporately manages and ensures the strategic availability of a minimum, critical suite of aeronautical test facilities (like wind tunnels), support aircraft, laboratories, and the western aeronautical test range, necessary to meet the long-term aeronautical test requirements for the Nation.

SCAP identifies, prioritizes, and manages Agency key assets and capabilities that are essential to the future needs of NASA and/or the Nation, including some capabilities that lack an adequate business base. This function ensures that key assets and capabilities, as elements of NASA’s physical and intellectual infrastructure, are available to perform NASA’s Mission. They perform an Agency crosscutting function that encompasses assets and capabilities that may be used across multiple mission directorates and program areas.

Reported Multi-Year Performance

Multi-Year Performance Goal 5.3.1.1: Develop and execute the Rocket Propulsion Test (RPT) Master Plan.

FY11	NASA approved the RPT Master Plan on July 11, 2011, and has followed it since that time. The RPT Program added over 10 new test requirements that will maintain activity in almost all primary as well as two secondary facilities. Progress toward mothball configurations in five test facilities (three at White Sands, two at MSFC) continued as planned. Should requirements of other NASA programs, including SLS, COTS, and CCDeV change, management processes currently in place will allow these facilities to be brought out of mothball status to meet these needs.
Green	
FY12	
Green	

Update to Multi-Year Performance Goal	
FY13 Update	Review the current state of the NASA test capabilities, known test requirements and test requests, and revise the Master Plan as needed.
FY14	This performance goal remains the same in FY14.

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Reported Annual Performance					
SFS-12-1: Meet Rocket Propulsion Test (RPT) Master Plan requirements for year one.					
Contributing Theme:		Space and Flight Support			
Contributing Program(s):		Rocket Propulsion Test			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	9SFS3 Yellow	10SFS09 Yellow	SFS-11-1 Green	SFS-12-1 Green
Planned Annual Performance					
FY13 Update	SFS-13-1: Incorporate test capability modifications and known test requirements in the yearly Rocket Propulsion Test (RPT) Master Plan update.				
FY14	SFS-14-1: Sustain 90 percent availability of Test Facilities to support NASA Test Requirements.				

Reported Multi-Year Performance

Multi-Year Performance Goal 5.3.2.1: Ensure that testing capabilities are available in order to support the research, development, test and engineering milestones of NASA and Department of Defense (DoD) programs.

FY11	NASA annually evaluates, in coordination with DoD, the status of its assets to ensure that tactical maintenance and repair and strategic technology development and capability investment decisions have been considered from a national point-of-view relative to long-term requirements and risks. In doing so, the program ensures the availability of a critical suite of aeronautical test facilities that are capable of supporting the research, development, test, and evaluation goals and objectives for NASA and the Nation. Facility condition assessments were completed in FY 2012, which provided data to inform strategic investment decisions and to identify and address critical maintenance issues. NASA will continue to mitigate operational risks through periodic condition assessments and sound tactical and strategic investments to ensure a portfolio that is ready for those who need to test and validate.
Green	
FY12	NASA successfully executed more than 10,000 hours of ground testing and approximately 800 hours of flight testing for NASA and the Nation, achieving high overall customer satisfaction ratings and excellent facility availability and performance. Ground test examples include operations in the Glenn Research Center's (GRC's) 9x15-foot Low Speed Wind Tunnel for low speed aerodynamic, aeromechanical, and aeroacoustic testing of a series of second generation, counter-rotating (open rotor) blade sets to determine the efficiency and noise characteristics for advanced ultra-high bypass engine applications. Flight test examples include a project titled Waveform and Sonic Boom Perception and Response (WSPR) at Dryden Flight Research Center (DFRC), which involved gathering "first ever" qualitative data from supersonic flights of sonic boom impact and acceptability from a select group of more than 100 volunteer Edwards Air Force Base residents.
Green	
	NASA also continued to address critical shortfalls identified in the 2012 National Aeronautics Research, Development, Test, and Evaluation Infrastructure Plan through efforts directed towards engine icing research at the Propulsion Simulation Laboratory at GRC and acoustic measurement at the 14x22-foot Tunnel at Langley Research Center. Investments in test technology included advanced facility electronic systems required to

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	<p>meet modern research testing requirements and targeted investments in wind tunnel force measurement systems.</p> <p>In addition, NASA completed a project to modify an existing G-III subsonic research aircraft testbed at DFRC, which will result in new experimental test capability to assess emerging flight technologies. One of the first intended uses of the aircraft is to enable NASA to explore and mature alternative unconventional aircraft designs with the potential to simultaneously meet research goals for community noise, fuel burn, and nitrogen oxides emissions.</p> <p>For more information about NASA's Aeronautics Test Program, go to http://www.aeronautics.nasa.gov/atp/index.html.</p>
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Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
AR-12-14: Achieve ratings greater than 86 percent for overall quality and timeliness of Aeronautics Test Program (ATP) facility operations.					
Contributing Theme:		Aeronautics			
Contributing Program(s):		Aeronautics Test			
FY07	FY08	FY09	FY10	FY11	FY12
7AT7 Green	8AT16 Yellow	None	10AT11 Green	AR-11-11 Green	AR-12-14 Green
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	No annual performance goal in FY14.				
Comments	ATP is replacing its APGs that reflect day-to-day operational performance with strategically focused goals.				

Reported Annual Performance	
No annual performance goal in FY12 or trended performance.	
Contributing Theme:	Aeronautics
Contributing Program(s):	Aeronautics Test
Planned Annual Performance	
FY13 Update	AR-13-8: Provide a new engine icing test capability to address the high-altitude engine icing problem encountered by commercial aircraft.
FY14	AR-14-10: Execute data acquisition and control systems upgrades for the Glenn Research Center 10'x10' Supersonic Wind Tunnel.

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Reported Annual Performance	
No annual performance goal in FY12 or trended performance.	
Contributing Theme:	Aeronautics
Contributing Program(s):	Aeronautics Test
Planned Annual Performance	
FY13 Update	AR-13-9: Perform a condition assessment of the ground support facilities, systems, and equipment within the Flight Test Project portfolio.
FY14	AR-14-11: Execute data measurement techniques and flow quality improvements at the Langley Research Center National Transonic Facility

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OUTCOME 5.4: IMPLEMENT AND PROVIDE SPACE COMMUNICATIONS AND LAUNCH CAPABILITIES RESPONSIVE TO EXISTING AND FUTURE SCIENCE AND SPACE EXPLORATION MISSIONS.

Both human and robotic space exploration require an efficient and reliable infrastructure of assets, facilities, and services to keep operations running smoothly. These include access to launch vehicles, launch and range complexes, and a communication network to receive and transmit data.

The [Launch Services Program \(LSP\)](#) is responsible for understanding the full range of civil space launch needs. They work closely with other government agencies and the launch industry to make available the safest, most reliable, on-time, and cost-effective commercial launch opportunities over a wide range of launch systems. LSP personnel work with customers from universities, industry, government agencies, and international organizations from the earliest phase of mission planning to purchase of fixed-price launch services from domestic suppliers. LSP personnel also seek opportunities to share unused payload capacity aboard non-NASA launches to leverage launch funds. Most importantly, they provide oversight to help NASA's valuable, one-of-a-kind missions achieve their space flight objectives.

The [Human Exploration and Operations Mission Directorate \(HEOMD\)](#) and the Kennedy Space Center have been working to prepare the Center for future government and commercial space exploration by transitioning, refurbishing, and upgrading facilities. This includes launch pads and the launch control center.

[Space Communications and Navigation \(SCaN\)](#) coordinates multiple space communications networks, as well as network support functions to regulate, maintain, and expand NASA's space communications and navigation capabilities in support of all NASA's space missions. These networks include satellites that relay data from mission spacecraft to the ground and ground assets and facilities. SCaN reviews national and international data standards with the aim to keep systems compatible and reviews the Agency's technology needs to keep the systems efficient, reliable, and cost-effective. They also are developing a communication and navigation architecture to serve NASA's needs through 2030.

Reported Multi-Year Performance

Multi-Year Performance Goal 5.4.1.1: Complete Launch Services Program (LSP) objectives for all NASA-managed expendable launches.

FY11	In FY 2012, NASA's Launch Services Program sustained a 100 percent success rate with the launch of four NASA-managed launches, including the Suomi National Polar-orbiting Partnership (NPP) aboard a Delta II from Vandenberg Air Force Base, California, on October 28, 2011, the Mars Science Laboratory (MSL) on November 26 aboard an Atlas V from Cape Canaveral, Florida, the Nuclear Spectroscopic Telescope Array (NuSTAR) aboard a Pegasus XL rocket from Kwajalien Atoll on June 13, 2012, and the Van Allen Probes aboard an Atlas V-401 rocket from Cape Canaveral Air Force Station, Florida, on August 30.
Green	
FY12	
Green	

Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

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Reported Annual Performance					
SFS-12-2: Sustain 100 percent success rate with the successful launch of NASA-managed expendable launches as identified on the Launch Services Flight Planning Board manifest.					
Contributing Theme:		Space and Flight Support			
Contributing Program(s):		Launch Services			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	10SFS11 Green	SFS-11-2 Yellow	SFS-12-2 Green
Planned Annual Performance					
FY13 Update	SFS-13-2: Sustain a 100 percent success rate with the successful launch of NASA managed expendable launches as identified on the Launch Services Flight Planning Board manifest.				
FY14	SFS-14-2: Sustain a 100 percent success rate with the successful launch of NASA managed expendable launches as identified on the Launch Services Flight Planning Board manifest.				

Reported Annual Performance	
No annual performance goal in FY12 or trended performance.	
Contributing Theme:	Space and Flight Support
Contributing Program(s):	Launch Services
Planned Annual Performance	
FY13 Update	No annual performance goal in FY13.
FY14	SFS-14-3: Complete acquisitions on-time for NASA-managed expendable launches.

Reported Multi-Year Performance

Multi-Year Performance Goal 5.4.1.2: Continue utilizing existing contract mechanisms and agreements with emerging launch vehicle providers to gain information for future Launch Service orders and to provide technical exchanges to enhance early launch success.

FY11	NASA released a Request for Launch Services Proposal for the Jason-3 Earth science mission on the NASA Launch Services (NLS) II contract on March 21, 2012. Following the receipt and evaluation of all proposals, on July 16, 2012, NASA awarded the launch service for the Jason-3 mission to an emerging provider, SpaceX and their Falcon 9v1.0 launch vehicle. Jason-3 requires a Category 2 (medium risk) launch service, and the certification strategy was briefed to the Flight Planning Board on July 24, 2012. Meetings at all levels between NASA and SpaceX have ramped up to address the challenges of certifying a new launch vehicle for NASA's Jason-3.
Green	
FY12	
Green	

Update to Multi-Year Performance Goal	
FY13 Update	No performance goal in FY13.
FY14	No performance goal in FY14.

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Reported Annual Performance					
SFS-12-3: Incorporate information sharing processes into policies addressing new entrant launch vehicle certification activities and future space transportation service contracts.					
Contributing Theme:		Space and Flight Support			
Contributing Program(s):		Launch Services			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	10SFS10 Green	SFS-11-3 Green	SFS-12-3 Green
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	No annual performance goal in FY14.				
Comments	The original description for SFS-12-3 was: "Incorporate information sharing processes into programmatic policies and incorporate into crew demonstration activities and future crew transportation service contract." NASA updated the measure to reflect that the reference to crew space transportation partner information sharing, which would include other U.S. Government agencies, was incorrect, since none beyond NASA have crewed space flight. NASA's Launch Services Program partnership with the Department of Defense for space transportation is focused on launch vehicle certification of non-crewed flights, to the benefit of both organizations. NASA rated the measure after making the correction.				

Reported Multi-Year Performance

Multi-Year Performance Goal 5.4.2.1: By FY 2014, enable future government and commercial launching and testing from the Florida launch and range complex.

FY11	Exploration Ground Systems (EGS) and 21st Century Space Launch Complex (21st CSLC) activities are on track to provide capabilities for Orion, including the Exploration Flight Test (EFT)-1, SLS, as well as other government and commercial users. The 21st CSLC is an ongoing initiative (through 2018), with continuous improvements being made to the launch site infrastructure to meet the demands by commercial entities.
Green	
FY12	
Green	NASA signed and approved the program plan for EGS on June 29, 2012, and EGS held an internal SRR/SDR board on August 30, 2012. This was a critical milestone in EGS' concept design phase. The Ground Systems Development Operations Program held its Key Decision Point-B review in the first quarter of FY 2013, allowing the program to begin formulation.

Update to Multi-Year Performance Goal	
FY13 Update	Prioritize and complete launch and range complex modernization studies and projects to sustain government and commercial capabilities at the Kennedy Space Center (KSC) and Cape Canaveral Air Force Station (CCAFS).
FY14	Prioritize and complete launch and range complex modernization studies and projects to sustain government and commercial capabilities at the Kennedy Space Center (KSC) and Cape Canaveral Air Force Station (CCAFS).

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Reported Annual Performance					
SFS-12-4: Complete the 21st Century Space Launch Complex (21st CSLC) System Requirements Review/System Design Review.					
Contributing Theme:		Space and Flight Support			
Contributing Program(s):		21st Century Space Launch Complex			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	SFS-11-4 Yellow	SFS-12-4 Green
Planned Annual Performance					
FY13 Update	SFS-13-3: Continue to establish and develop the 21st Century Space Launch Complex (21stCSLC) and implement the modifications identified during the FY 2011 initiated studies.				
FY14	No annual performance goal in FY14.				
Comments	NASA changed the language of the APG for FY 2013 to clarify the measurement to be made.				

Reported Annual Performance	
No annual performance goal in FY12 or trended performance.	
Contributing Theme:	Exploration Systems and Development
Contributing Program(s):	Exploration Ground Systems
Planned Annual Performance	
FY13 Update	ESD-13-3: Complete the transfer of required Space Shuttle Program (SSP) and Constellation Program (CxP) assets to the Exploration Ground Systems (EGS) Program for use by SLS/MPCV at the Kennedy Space Center.
FY14	ESD-14-3: Complete the Exploration Ground Systems Program Preliminary Design Review (PDR).

Reported Multi-Year Performance

Multi-Year Performance Goal 5.4.3.1: By 2014, launch two functionally identical Tracking and Data Relay Satellite (TDRS) spacecraft in geosynchronous orbits to replenish the Tracking and Data Relay Satellite System (TDRSS) constellation.

FY11	Since 1983, the TDRS constellation of satellites has played a major role in maintaining a reliable communications network for NASA with critical, non-interrupted connections to missions like ISS and the Hubble Space Telescope. NASA engineers recognize the fleet is aging and are working to replenish the fleet with two new TDRS satellites. The first spacecraft, TDRS-K, is on schedule to launch in January 2013. TDRS-K passed its Pre-Ship Review in September 2012 and awaited shipment from the contractor's satellite assembly facility to Cape Canaveral, Florida in December. The second spacecraft, TDRS-L, is manifested for launch no earlier than February 2014.
Green	
FY12	
Green	

Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

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Reported Annual Performance					
SFS-12-5: Complete Tracking and Data Relay Satellite (TDRS) K Pre-ship Review.					
Contributing Theme:		Space and Flight Support			
Contributing Program(s):		Space Communications and Navigation			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	9SFS6 Green	10SFS07 Yellow	SFS-11-5 Green	SFS-12-5 Green
Planned Annual Performance					
FY13 Update	SFS-13-4: Complete TDRS L Pre-Ship Review.				
FY14	SFS-14-4: Complete In-Orbit check-out of TDRS L spacecraft.				
Comments	The original APG released with the FY 2013 Performance Plan was to “[p]repare TDRS L for its Flight Readiness Review (FRR).” NASA has corrected this to completing the Pre-Ship Review, which is the milestone that ensures the spacecraft is prepared for its flight readiness review.				

Reported Multi-Year Performance

Multi-Year Performance Goal 5.4.3.2: By FY 2016, replace or upgrade obsolete and unsustainable systems of the TDRSS Ground Segment at the White Sands Complex (WSC).

FY11	TDRSS incorporates a fleet of TDRS spacecraft connected in real time to a series of ground stations and data facilities. NASA is in the process of upgrading the ground segment to better serve the spacecraft. The Space Network Ground Segment Sustainment (SGSS) project successfully passed its Preliminary Design Review on June 7, 2012. SGSS is responsible for redesigning the architecture and function of two ground stations at the White Sands Complex (WSC) in White Sands, NM, and a TDRSS terminal at the Guam Remote Station.
Green	
FY12	
Green	

Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
SFS-12-6: Complete the Space Network Ground Segment Sustainment (SGSS) Preliminary Design Review (PDR).					
Contributing Theme:		Space and Flight Support			
Contributing Program(s):		Space Communications and Navigation			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	10SFS08 Yellow	SFS-11-6 Green	SFS-12-6 Green
Planned Annual Performance					
FY13 Update	SFS-13-5: Complete Space Network Ground Segment Sustainment (SGSS) Critical Design Review (CDR).				
FY14	SFS-14-5: Complete Space Network Ground Segment Sustainment (SGSS) Systems Integration Review (SIR).				

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Reported Multi-Year Performance

Multi-Year Performance Goal 5.4.3.3: By FY 2018, replace aging and obsolete Deep Space Network (DSN) 70-meter antenna at Canberra Deep Space Communications Complex (CDSCC).

FY11	<p>NASA has determined that to meet the on-going demand for deep space communication services, it needs a number of new Deep Space Station antennas at its three Deep Space Network (DSN) sites. NASA's Space Communications and Navigation (SCaN) office is developing an array of four 34-meter antennas, which are easy to maintain and can provide the same or better performance as the 70-meter antennas. The DSN Aperture Enhancement Project (DAEP) passed its Preliminary Design Review in April 2012.</p> <p>The first step in the DAEP is now under construction at CDSCC in Australia. SCaN has poured the antenna's foundation (pedestal) and has procured long-lead antenna items, with all activities completed in a timely manner. Information provided at monthly Program Management Reviews supports the delivery dates, as well as scheduled design reviews for this effort.</p>
Green	
FY12	
Green	

Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
SFS-12-7: Complete Deep Space Station-35 (DSS-35) antenna fabrication at vendor.					
Contributing Theme:		Space and Flight Support			
Contributing Program(s):		Space Communications and Navigation			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	SFS-11-7 Green	SFS-12-7 Green
Planned Annual Performance					
FY13 Update	SFS-13-6: Complete antenna structure for DSS-35 at the CDSCC.				
FY14	SFS-14-6: Complete the RF equipment installation at CDSCC to support operations.				

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OUTCOME 5.5: ESTABLISH PARTNERSHIPS, INCLUDING INNOVATIVE ARRANGEMENTS, WITH COMMERCIAL, INTERNATIONAL, AND OTHER GOVERNMENT ENTITIES TO MAXIMIZE MISSION SUCCESS.

Strategic partnerships with the U.S. Government and academic, industrial, and international organizations help NASA leverage resources, increase the impact of activities, and execute missions more effectively and efficiently. NASA works cooperatively with these partners to identify common goals, develop new technologies and applications, and share technical expertise to minimize risk. The [Office of International and Interagency Relations \(OIIR\)](#) provides executive leadership and coordination for all international partnerships. OIIR serves as the principal Agency liaison with the [National Security Council](#), the [Office of Science and Technology Policy](#), the [Department of State](#), and the [Department of Defense](#). OIIR also directs NASA’s international relations, negotiates cooperative and reimbursable agreements with foreign space partners, provides management oversight and staff support of NASA’s advisory committees, commissions, and panels, and manages the NASA Export Control Program and foreign travel by NASA employees.

To achieve this outcome, NASA uses mechanisms like building public–private partnerships, hosting government capabilities on commercial spacecraft, and purchasing scientific or operational data products from commercial satellites. The ability to procure technology or services competitively when needed, rather than maintain a capability that may not be fully used, allows NASA to focus resources for institutional and program capabilities in areas of evolving strategic importance.

Reported Multi-Year Performance

Multi-Year Performance Goal 5.5.2.1: Actively engage and provide leadership in international and interagency forums.

FY11	<p>NASA, led by OIIR, actively engaged and provided leadership in international and interagency forums leading the U.S. delegation, which included seven U.S. Federal Agencies, to the Scientific and Technical Subcommittee sessions of the United Nations Committee on the Peaceful Uses of Outer Space, held February 6-17, 2012, and June 6-15, 2012.</p> <p>The charter establishing the Interagency Partnership Working Group (IPWG) was approved on April 5, 2011. The IPWG, led by OIIR, conducted three meetings, on May 12, 2011, November 29, 2011, and August 9, 2012. OIIR led the effort to draft and seek Agency concurrence on the IPWG charter, which was approved by NASA Headquarters officials-in-charge for the Administrator’s Office, OIIR, the Office of Education, the Office of the Chief Technologist, the Science Mission Directorate, the Mission Support Directorate, the Office of Independent Program and Cost Evaluation, the Office of the General Counsel, the Office of the Chief Scientist, and the former Exploration Systems Mission Directorate and Space Operations Mission Directorate (which have since been merged into the Human Exploration Mission Directorate). The IPWG membership includes a senior representative from each office that concurred on the charter, as adjusted to reflect the current NASA organizational structure.</p>
Green	
FY12	
Green	

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Update to Multi-Year Performance Goal	
FY13 Update	Continue and improve coordination of NASA's international and interagency agreement activities.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
AMO-12-18: Establish an internal Interagency Partnerships Working Group (IPWG) led by the Office of International and Interagency Relations (OIIR) to improve Agency-wide coordination of interagency partnerships and related interagency working groups.					
Contributing Theme:		Agency Management and Operations			
Contributing Program(s):		Agency Management			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	AMO-11-18 Green	AMO-12-18 Green
Planned Annual Performance					
FY13 Update	AMO-13-10: Implement improved management of existing agreements by incorporating Office of International and Interagency Relations (OIIR)-led interagency agreements into the Agency agreements database (i.e., the Space Act Agreement Maker).				
FY14	AMO-14-9: Continue to play a primary role in planning and coordinating NASA and other U.S. Government agency participation in the United Nations Committee on the Peaceful Uses of Outer Space by expanding international cooperation beyond major space faring nations.				

Reported Multi-Year Performance

No Multi-Year Performance Goal in FY12.

FY11
Green
FY12
None

Update to Multi-Year Performance Goal	
FY13	5.5.1.1: Working with the ISS National Laboratory management entity, expand utilization of ISS by non-NASA organizations.
FY14	No performance goal in FY14.

Reported Annual Performance	
No annual performance goal in FY12 or trended performance.	
Contributing Theme:	International Space Station
Contributing Program(s):	International Space Station

PERFORMANCE REPORTING AND PLANNING

Planned Annual Performance	
FY13 Update	ISS-13-9: Facilitate the non-profit organization's (NPO) establishment of the ISS National Laboratory Marketplace to allow researchers and prospective investors to interact and to demonstrate its effectiveness by producing at least one externally funded research agreement.
FY14	No annual performance goal in FY14.

PERFORMANCE REPORTING AND PLANNING

Strategic Goal 6: Share NASA with the public, educators, and students to provide opportunities to participate in our Mission, foster innovation, and contribute to a strong national economy.

OUTCOME 6.1: IMPROVE RETENTION OF STUDENTS IN STEM DISCIPLINES BY PROVIDING OPPORTUNITIES AND ACTIVITIES ALONG THE EDUCATION PIPELINE.

A critical part of NASA’s Mission is to inspire the next generation of explorers so that the Nation’s preeminence in space exploration, aeronautics, and science can continue into the future. NASA educational tools are designed to capture student interest, nurture their natural curiosities, and excite their minds. By providing hands-on opportunities to students of all ages and their educators, and engaging them in simulations and authentic research, NASA stimulates creativity and encourages the growth of a new generation of scientists and engineers.

Many of NASA’s grant recipients are university and college science, technology, engineering, and mathematics (STEM) programs. [NASA Education](#) and [Office of Diversity and Equal Opportunity \(ODEO\)](#) partner to realize the goals of equal opportunity requirements amongst STEM and related programs receiving NASA financial assistance, including grants for education and training. Under laws prohibiting discrimination in federally funded programs, like Title VI of the Civil Rights Act of 1964 and Title IX of the Education Amendments Act of 1972, ODEO conducts compliance and enforcement activities to ensure that these programs afford equal opportunities to their beneficiaries, regardless of race, color, national origin, gender, age, or disability, and that the programs are free of discrimination and harassment. NASA Education and ODEO also review the equal opportunity technical assistance given to STEM programs. Equal opportunity technical assistance provides recipient programs more effective tools for conducting and measuring the success of targeted diversity outreach and recruitment efforts. The goal of technical assistance also is to achieve and maintain STEM program environments that are welcoming to more broadly diverse student bodies, ensuring greater diversity participation and retention in such programs.

Reported Multi-Year Performance

Multi-Year Performance Goal 6.1.1.1: Provide educators nationwide with knowledge and tools with which to inspire students in STEM fields.

FY11	During FY 2012, 183,040 educators participated in NASA education programs, exceeding the target of 35,000. The Office of Education is proud of its achievements in this area. Education plans to continue to perform well in this area, with offerings of NASA-unique professional development experiences and materials for educators.
Green	
FY12	
Green	

PERFORMANCE REPORTING AND PLANNING

Update to Multi-Year Performance Goal	
FY13 Update	Assure the availability and accessibility of NASA's online curricular support and resources to improve educators' STEM content knowledge and enhance student interest and proficiency in STEM disciplines.
FY14	This performance goal remains the same in FY14.
Comments	NASA revised the language of this performance goal for FY 2013 to clarify what performance is being assessed.

Reported Annual Performance					
ED-12-3: 35,000 educators participate in NASA education programs.					
Contributing Theme:		Education			
Contributing Program(s):		STEM Education and Accountability			
FY07	FY08	FY09	FY10	FY11	FY12
7ED6	8ED05	9ED7	10ED07	ED-11-3	ED-12-3
Green	Green	Green	Green	Green	Green
Planned Annual Performance					
FY13 Update	ED-13-2: Maintain no fewer than 1,000 online STEM-based teaching tools for K-12 and informal educators and higher education faculty.				
FY14	ED-14-2: Maintain no fewer than 1,000 online STEM-based teaching tools for K-12 and informal educators and higher education faculty.				

Reported Multi-Year Performance

Multi-Year Performance Goal 6.1.2.1: Provide higher education students with authentic NASA mission-based opportunities that build knowledge and skills needed for STEM careers.

FY11	34,032 undergraduate and graduate students participated in NASA education opportunities, exceeding the target of 20,000. The Office of Education hopes to continue to achieve in this area by increasing the availability of NASA resources and opportunities to a diverse audience of educators and students, including women, minorities, and persons with disabilities.
Green	
FY12	
Green	
	One such activity in FY 2012 where NASA provided a mission-based opportunity was through the Tribal Colleges and Universities (TCU) project. The TCU project offers a Research Experience for Undergraduates (REUs) specifically designed for the tribal community often referred to as an externship. This externship program, led by Kiksapa Consulting LLC, a NASA grantee, focuses on climate change education and training in geospatial technologies through NASA REUs hosted in tribal lands and communities rather than at a NASA field center. The externship program was specially designed to accommodate students who have family or personal obligations that would otherwise prevent them from participating in the traditional 10-week NASA internship held at a NASA field center. In this reporting cycle, 12 TCU faculty and student teams participated in the externship program.

Update to Multi-Year Performance Goal	
FY13 Update	No performance goal in FY13.
FY14	No performance goal in FY14.

PERFORMANCE REPORTING AND PLANNING

Reported Annual Performance					
ED-12-4: 20,000 undergraduate and graduate students participate in NASA education opportunities.					
Contributing Theme:		Education			
Contributing Program(s):		STEM Education and Accountability			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	9ED6 Green	10ED05 Green	ED-11-4 Green	ED-12-4 Green
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	No annual performance goal in FY14.				

Reported Multi-Year Performance

Multi-Year Performance Goal 6.1.2.2: Provide elementary and secondary students with authentic NASA mission-based opportunities that build STEM knowledge, skills and career awareness.

FY11	<p>During FY 2012, 1,184,786—well over the target of 200,000—elementary and secondary students participated in NASA instructional and enrichment activities. The Office of Education underestimated its ability to achieve this measure. This success is partly due to an increased focus on partnerships. Examples of FY 2012 Office of Education partnerships and collaborations include Space Act agreements with industry leaders such as LEGO, Federal and state collaborations like the Department of Education’s 21st Century Community Learning Centers (CCLC), and academic partnerships that help NASA increase participation with the Nation’s minority-serving institutions. Education plans to continue to perform well in this area with a continued commitment of increased work with partners.</p> <p>Eighty-four percent of elementary and secondary students express interest in STEM careers following their involvement in NASA education programs—less than one percent below the target of 85 percent. The Office of Education believes this is due to the unique hands-on experiences that NASA is able to provide when sharing mission-related content.</p> <p>Also in FY 2012, NASA partnered with science centers, museums, planetariums, and community-based education providers to allow informal educators to engage students in NASA’s real-time, cutting-edge science and engineering discoveries and challenges. NASA’s Summer of Innovation activity exemplified this approach by engaging and supporting external partners in the delivery of evidence-based summer engagement opportunities in STEM to youth from underserved and underrepresented populations with the intent of increasing interest and participation in STEM and contributing toward the national-level impact of increased numbers of high school graduates pursuing STEM majors and careers.</p>
FY12	

PERFORMANCE REPORTING AND PLANNING

Update to Multi-Year Performance Goal	
FY13 Update	Focus resources, including content, facilities, and personnel, to improve the impact of NASA's STEM education efforts on areas of greatest national need, as identified in the 2011 NASA Education Design Team report, ensuring that NASA-unique assets are leveraged when conducting direct-service student activities.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
ED-12-5: 200,000 elementary and secondary students participate in NASA instructional and enrichment activities.					
Contributing Theme:		Education			
Contributing Program(s):		STEM Education and Accountability			
FY07	FY08	FY09	FY10	FY11	FY12
7ED6 Green	8ED04 Green	9ED8 Green	10ED08 Green	ED-11-5 Green	ED-12-5 Green
Planned Annual Performance					
FY13 Update	ED-13-3: Conduct no fewer than 200 interactive K-12 student activities that leverage the unique assets of NASA's missions.				
FY14	ED-14-3: Conduct no fewer than 200 interactive K-12 student activities that leverage the unique assets of NASA's missions.				

Reported Annual Performance					
ED-12-6: 85 percent of elementary and secondary students express interest in STEM careers following their involvement in NASA education programs.					
Contributing Theme:		Education			
Contributing Program(s):		STEM Education and Accountability			
FY07	FY08	FY09	FY10	FY11	FY12
7ED4 None	None	9ED10 Green	10ED06 Green	ED-11-6 Green	ED-12-6 Green
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	No annual performance goal in FY14.				

Reported Multi-Year Performance

Multi-Year Performance Goal 6.1.3.1: Promote equal opportunity compliance and encourage best practices among NASA grant recipient institutions.

FY11	NASA conducts a vigorous program of civil rights compliance reviews of its grantees, including post-award onsite and desk-audit reviews and pre-award reviews. The Agency's external civil rights technical assistance efforts achieved a major milestone during FY 2012 with the publication of a new resource tool for grantees to conduct their own Title IX self-evaluations, titled <i>Title IX & STEM: A Guide to Conducting Self-Evaluations for Science, Technology, Engineering, and Mathematics Programs</i> (released in June 2012). In addition to being posted online in interactive format, NASA disseminated it in hard copy to NASA
Green	
FY12	
Green	

PERFORMANCE REPORTING AND PLANNING

	<p>educational institution grantees. It also was showcased as part of the White House Council on Women and Girls activities commemorating the 40th anniversary of Title IX, held June 20, 2012.</p> <p>NASA's external civil rights program continues to be recognized as a leader in the field by the Department of Justice Civil Rights Division and external stakeholder organizations, such as the Society of Women Engineers and the Association of Women in Science.</p>
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Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
AMO-12-19: Provide equal opportunity (EO) assessment and technical assistance, or onsite compliance assessment on-location, at a minimum of three STEM or STEM-related programs that receive NASA funding.					
Contributing Theme:		Agency Management and Operations			
Contributing Program(s):		Agency Management			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	10WF11 Green	AMO-11-19 Green	AMO-12-19 Green
Planned Annual Performance					
FY13 Update	AMO-13-11: Provide equal opportunity (EO) assessment and technical assistance, or on-site compliance assessment on-location, at a minimum of two STEM or STEM-related programs that receive NASA funding.				
FY14	AMO-14-10: Broaden the scope of civil rights technical assistance to NASA grantees through the MissionSTEM Website on grantee civil rights requirements and promising practices for grantee compliance and diversity and inclusion.				
Comments	NASA altered the language of this APG for FY 2013 to clarify the measurement to be made.				

Reported Annual Performance	
No annual performance goal in FY12 or trended performance.	
Contributing Theme:	Agency Management and Operations
Contributing Program(s):	Agency Management
Planned Annual Performance	
FY13 Update	No annual performance goal in FY13.
FY14	AMO-14-11: Provide civil rights compliance assessment at a minimum of two STEM or STEM-related programs that receive NASA funding.

PERFORMANCE REPORTING AND PLANNING

OUTCOME 6.2: PROMOTE STEM LITERACY THROUGH STRATEGIC PARTNERSHIPS WITH FORMAL AND INFORMAL ORGANIZATIONS.

The complexity of meeting formal and informal education needs and requirements demands a highly collaborative approach. Through strategic partnerships, [NASA Education](#) leverages the resources and expertise of its partners, scales its investments to reach new audiences, and expands established networks. Tapping into partners' creativity and innovation helps disseminate NASA's products and services in a broader and more systematic manner to reach new users more effectively.

NASA provides numerous opportunities for K–12 educators to engage directly with the science and engineering work conducted by the NASA mission directorates. NASA Education works with local, state, and Federal organizations to ensure that NASA's services and products provide information and opportunities that are appropriate, meet established needs, and support ongoing STEM initiatives.

Reported Multi-Year Performance

Multi-Year Performance Goal 6.2.1.1: Provide educator professional development experiences and materials that align to needs and opportunities identified by districts, states, Department of Education, professional organizations, and other stakeholders.

FY11	In FY 2012, 65 percent of educators reported via survey that they used NASA resources after participating in NASA professional development, exceeding NASA's target of 50 percent. The Office of Education plans to continue to perform well in this area.
Green	
FY12	NASA's Office of Education partnered with universities, professional education associations, industry, and other Federal agencies to provide K-12 teachers and university faculty with experiences that capitalize on the excitement of NASA discoveries to spark student interest and involvement in STEM.
Green	

Update to Multi-Year Performance Goal	
FY13 Update	No performance goal in FY13.
FY14	No performance goal in FY14.

Reported Annual Performance					
ED-12-7: 50 percent of educators use NASA resources in their curricula after participating in NASA professional development as measured by survey responses.					
Contributing Theme:		Education			
Contributing Program(s):		STEM Education and Accountability			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	ED-11-7 Yellow	ED-12-7 Green
Planned Annual Performance					
FY13 Update	No annual performance goal in FY13.				
FY14	No annual performance goal in FY14.				

PERFORMANCE REPORTING AND PLANNING

Reported Multi-Year Performance

No Multi-Year Performance Goal in FY12 or trended performance.

Update to Multi-Year Performance Goal	
FY13	6.2.1.3: Increase NASA's engagement in national STEM education policy discussions to improve curricula, inform national standards in STEM subjects, and ensure coordination and sharing of best practices across federal STEM agencies to avoid duplication, overlap, or fragmentation.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance	
No annual performance goal in FY12 or trended performance.	
Contributing Theme:	Education
Contributing Program(s):	STEM Education and Accountability
Planned Annual Performance	
FY13 Update	ED-13-4: Participate in no fewer than 20 STEM education advisory boards, STEM-related committees, or other events or activities related to national STEM education policy.
FY14	ED-14-4: Participate in no fewer than 20 STEM education advisory boards, STEM-related committees, or other events or activities related to national STEM education policy.

PERFORMANCE REPORTING AND PLANNING

OUTCOME 6.3: ENGAGE THE PUBLIC IN NASA'S MISSIONS BY PROVIDING NEW PATHWAYS FOR PARTICIPATION.

NASA encourages active participation in the Agency's programs and Mission, consistent with the philosophy of government transparency. Through participatory engagement, NASA seeks to include the public in the adventure and excitement of its activities and tap into individual creativity and capabilities to enhance its work in science, discovery, and exploration.

NASA's participatory engagement activities, led by the Office of Communications, span the communications spectrum ranging from passive activities, like watching online NASA videos, to highly interactive activities that use NASA-related social media tools or provide hands-on experiences. NASA also uses these activities to collaborate with the public on interpretation of data and discoveries. By increasing the mechanisms through which the public can directly and specifically contribute to NASA's missions, the Office of Communications can bring additional creativity and capability to some of the biggest challenges, and leverage NASA's resources to accomplish more toward the Agency's goals.

Reported Multi-Year Performance

Multi-Year Performance Goal 6.3.1.1: By 2015, establish an Agency-wide portfolio of participatory engagement opportunities.

FY11	The Office of Communications awarded approximately \$525,000 in funding to the Sally Ride Science for EarthKam and Zero Robotics at the Massachusetts Institute of Technology for the SPHERES Program to advance the Agency's participatory engagement initiative. These were sole-source awards based on a management determination that participatory engagement resources would be better focused on leveraging existing opportunities. In addition, the office is developing a participatory engagement Web site, which will serve as an Agency-wide portfolio of participatory engagement opportunities.
Green	
FY12	
Green	

Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
AMO-12-20: Issue a competitive opportunity to engage the public in NASA's activities.					
Contributing Theme:		Agency Management and Operations			
Contributing Program(s):		Agency Management			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	AMO-11-20 Green	AMO-12-20 White
Why this APG was not achieved:					
The original plan was for NASA to use the April 2012 OpenGov International Apps Challenge as the venue for a competitive opportunity for participatory engagement of the public. In 2012, the Office of Communications management determined that the participatory engagement resources would be better focused on leveraging other existing activities and redirected the funds planned for the competitive opportunity.					

PERFORMANCE REPORTING AND PLANNING

Planned Annual Performance	
FY13 Update	AMO-13-12: Evaluate portfolio of participatory engagement activities and establish best practices.
FY14	AMO-14-12: Develop standardized Agency metrics for assessing success of participatory engagement activities.

PERFORMANCE REPORTING AND PLANNING

OUTCOME 6.4: INFORM, ENGAGE AND INSPIRE THE PUBLIC BY SHARING NASA'S MISSIONS, CHALLENGES, AND RESULTS.

The opportunities and means for sharing information have increased tremendously with the Internet, social media, and other new technologies. For scientific and programmatic announcements, NASA continues traditional communications activities like issuing press releases, hosting media events, and providing photographs and videos of missions and events. Additionally, the [Office of Education](#), the Office of Communications, and the mission directorates are expanding their content to reach more diverse audiences. For example, interactive experiences with astronauts, scientists, and engineers, through an online presence and other outreach events, are well-suited for engaging the public and students. As discussed in Outcome 6.3, the Office of Communications is taking advantage of recent and emerging technologies and media (Tweetups, live streaming video, social media) to deliver NASA information to a more diverse audience.

NASA shares the direct results of its missions by releasing scientific data to researchers and other government agencies. The Agency contributes data to online portals like www.data.gov allowing its use by anyone with the capability to access it. NASA Web sites host a wealth of mission and program information, and NASA participates fully in Administration initiatives for transparency by providing specific program and project information through information-sharing portals.

Reported Multi-Year Performance

Multi-Year Performance Goal 6.4.1.1: Leverage communities of practice to facilitate sharing of NASA successes and challenges with the public.

FY11	Through the NASA Museum Alliance , NASA involved over 420 museums and science centers in engaging the public in NASA activities. The Museum Alliance is a community of practice comprising informal science educators at museums, science centers, planetariums, observatory visitor centers, NASA visitor centers, Challenger Centers, zoos, aquariums, parks, and nature centers who wish to share NASA information with their visitors.
Green	
FY12	
Green	
	Exhibits, planetarium shows, and community-based programming are among 18 new grants NASA selected to receive agency funding in 2012. The awarded institutions consist of 11 informal education providers and seven NASA visitor centers that are sharing \$10 million resulting from the 63 proposals submitted through NASA Research Announcement entitled 2011 Competitive Program for Science Museums and Planetariums Plus Opportunities for NASA Visitor Centers and Other Informal Education Institutions.

Update to Multi-Year Performance Goal	
FY13 Update	Continue to provide opportunities for learners to engage in STEM education through NASA content provided to informal education institutions.
FY14	This performance goal remains the same in FY14.
Comments	NASA revised the language of this performance goal for FY 2013 to clarify what performance is being assessed.

PERFORMANCE REPORTING AND PLANNING

Reported Annual Performance					
ED-12-9: 420 museums and science centers across the country actively engage the public in major NASA events.					
Contributing Theme:		Education			
Contributing Program(s):		STEM Education and Accountability			
FY07	FY08	FY09	FY10	FY11	FY12
None	8ED06 Green	9ED11 Green	10ED10 Green	ED-11-9 Green	ED-12-9 Green
Planned Annual Performance					
FY13 Update	ED-13-5: Maintain the NASA Museum Alliance and/or other STEM Education strategic partnerships in no fewer than 30 states, U.S. Territories and/or the District of Columbia.				
FY14	ED-14-5: Maintain the NASA Museum Alliance and/or other STEM Education strategic partnerships in no fewer than 30 states, U.S. Territories and/or the District of Columbia.				

Reported Multi-Year Performance

Multi-Year Performance Goal 6.4.2.1: Use current and emerging communications technologies to reach increasingly broad audiences.

FY11	The Office of Communications continues to offer traditional media products such as media releases and NASA TV, and increased the reach of the Agency's social and new media activities. In FY 2012, NASA hosted 17 Socials , including the first ever multi-Center Social for the Curiosity landing. Socials provide opportunities for NASA's social media followers to learn and share information about NASA's missions, people, and programs. NASA is the second-most followed government agency on Twitter, with a total of almost three million followers. NASA continues to add new social media tools, such as Google+ Hangouts, which have been hosted by NASA scientists and officials like NASA Administrator Bolden. NASA TV provides coverage of daily mission operations and special events such as the Discovery fly over in the Washington area and Neil Armstrong memorial service.
Green	
FY12	
Green	

Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	This performance goal remains the same in FY14.

Reported Annual Performance					
AMO-12-21: Evaluate communication tools for impact and establish Agency best practices.					
Contributing Theme:		Agency Management and Operations			
Contributing Program(s):		Agency Management			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	AMO-11-21 Green	AMO-12-21 Green
Planned Annual Performance					
FY13 Update	AMO-13-13: Evaluate for effectiveness social media tools the Agency uses to expand public outreach.				
FY14	AMO-14-13: Assess the reach and effectiveness of programs that cultivate and deploy NASA employees to do public outreach.				

PERFORMANCE REPORTING AND PLANNING

Reported Multi-Year Performance

Multi-Year Performance Goal 6.4.3.1: Make available Agency records through the Freedom of Information Act (FOIA), Privacy Act, and Open Government Initiative in accordance with federal laws and regulations.

FY11 Green	The NASA FOIA office is responding to new FOIA cases in a timely fashion and has eliminated the historical backlog. The NASA FOIA office is continuing to work with Agency offices to streamline reporting practices to ensure a timely response to requests.
FY12 Green	
	The NASA FOIA office drafted the NASA FOIA regulations, which are planned for publication in FY 2013.

Update to Multi-Year Performance Goal	
FY13 Update	This performance goal remains the same in FY13.
FY14	Provide open access to NASA content for use by internal and external audiences.

Reported Annual Performance					
AMO-12-22: Finalize NASA Freedom of Information Act (FOIA) regulations.					
Contributing Theme:		Agency Management and Operations			
Contributing Program(s):		Agency Management			
FY07	FY08	FY09	FY10	FY11	FY12
None	None	None	None	AMO-11-22 Green	AMO-12-22 Green
Planned Annual Performance					
FY13 Update	AMO-13-14: Decrease the Freedom of Information (FOIA) backlog of requests by 10 percent.				
FY14	MO-14-14: Assess the use and reach of NASA content by external users.				

PERFORMANCE REPORTING AND PLANNING

Efficiency Measures

Reported Annual Performance					
AR-12-15 Deliver at least 86 percent of on-time availability for operations and research facilities.					
Contributing Theme:		Aeronautics			
Contributing Program(s):		Aeronautics Test			
FY07	FY08	FY09	FY10	FY11	FY12
7AT8 Yellow	8AT17 Yellow	9AT12 Green	10AT13 Green	AR-11-12 Yellow	AR-12-15 Green

Planned Annual Performance	
FY13 Update	No annual performance goal in FY13.
FY14	No annual performance goal in FY14.

Reported Annual Performance					
AS-12-6 Complete all development projects within 110 percent of the cost and schedule baseline.					
Contributing Theme:		Astrophysics			
Contributing Program(s):		Multiple Programs			
FY07	FY08	FY09	FY10	FY11	FY12
7UNIV9 Red	8AS09 Yellow	9AS12 Yellow	10AS11 Green	AS-11-6 White	AS-12-6 Yellow

Why this APG was not achieved:

NASA did not achieve this annual performance goal due to schedule growth that exceeded 10 percent of the estimated baseline at the Confirmation Review. The NuSTAR project realized 17 percent schedule growth due to delays in the launch provider's validation of flight software associated with the new launch vehicle flight computer and subsequent launch site availability issues. Based on these factors, the NuSTAR launch slipped from March to June 2012. Project costs, however, remained well within the threshold, at three percent growth from the confirmed baseline.

Planned Annual Performance	
FY13 Update	No annual performance goal in FY13.
FY14	No annual performance goal in FY14.

Reported Annual Performance					
AS-12-7 Deliver at least 90 percent of scheduled operating hours for all operations and research facilities.					
Contributing Theme:		Astrophysics			
Contributing Program(s):		Multiple Programs			
FY07	FY08	FY09	FY10	FY11	FY12
7UNIV10 Green	8AS10 Green	9AS13 Green	10AS12 Green	AS-11-7 Green	AS-12-7 Green

PERFORMANCE REPORTING AND PLANNING

Planned Annual Performance	
FY13 Update	No annual performance goal in FY13.
FY14	No annual performance goal in FY14.

Reported Annual Performance					
AS-12-8 Peer-review and competitively award at least 95 percent, by budget, of research projects.					
Contributing Theme:		Astrophysics			
Contributing Program(s):		Multiple Programs			
FY07	FY08	FY09	FY10	FY11	FY12
7UNIV11 Green	8AS11 Green	9AS14 Green	10AS13 Green	AS-11-8 Green	AS-12-8 Green

Planned Annual Performance	
FY13 Update	No annual performance goal in FY13.
FY14	No annual performance goal in FY14.

Reported Annual Performance					
AS-12-9 Maintain time within which 80 percent of NASA Research Announcement (NRA) grants are awarded, from proposal due date to selection, at no more than 180 days.					
Contributing Theme:		Astrophysics			
Contributing Program(s):		Multiple Programs			
FY07	FY08	FY09	FY10	FY11	FY12
7UNIV12 Green	8AS12 Yellow	9AS15 Green	10AS14 Green	AS-11-9 Green	AS-12-9 Green

Planned Annual Performance	
FY13 Update	No annual performance goal in FY13.
FY14	No annual performance goal in FY14.

Reported Annual Performance					
ES-12-20 Complete all development projects within 110 percent of the cost and schedule baseline.					
Contributing Theme:		Earth Science			
Contributing Program(s):		Multiple Programs			
FY07	FY08	FY09	FY10	FY11	FY12
7ESS21 Yellow	8ES15 Yellow	9ES21 Red	10ES17 Red	ES-11-19 Red	ES-12-20 Red
Why this APG was not achieved:					
NASA did not achieve this annual performance goal due to cost and schedule growth that exceeded 10 percent of the estimated baseline for the NPOESS Preparatory Project (NPP), which launched in FY 2012. The NPP project experienced delays due to on-going development issues with instruments provided by NASA's government partners.					

Planned Annual Performance	
FY13 Update	No annual performance goal in FY13.
FY14	No annual performance goal in FY14.

PERFORMANCE REPORTING AND PLANNING

Reported Annual Performance					
ES-12-21 Deliver at least 90 percent of scheduled operating hours for all operations and research facilities.					
Contributing Theme:		Earth Science			
Contributing Program(s):		Multiple Programs			
FY07	FY08	FY09	FY10	FY11	FY12
7ESS22 Green	8ES16 Yellow	9ES22 Green	10ES18 Green	ES-11-20 Green	ES-12-21 Green

Planned Annual Performance	
FY13 Update	No annual performance goal in FY13.
FY14	No annual performance goal in FY14.

Reported Annual Performance					
ES-12-22 Peer-review and competitively award at least 90 percent, by budget, of research projects.					
Contributing Theme:		Earth Science			
Contributing Program(s):		Multiple Programs			
FY07	FY08	FY09	FY10	FY11	FY12
7ESS23 Green	8ES17 Green	9ES23 Green	10ES19 Green	ES-11-21 Green	ES-12-22 Green

Planned Annual Performance	
FY13 Update	No annual performance goal in FY13.
FY14	No annual performance goal in FY14.

Reported Annual Performance					
ES-12-23 Reduce time within which 80 percent of NASA Research Announcement (NRA) grants are awarded, from proposal due date to selection, by four percent per year, with a goal of 180 days.					
Contributing Theme:		Earth Science			
Contributing Program(s):		Multiple Programs			
FY07	FY08	FY09	FY10	FY11	FY12
7ESS24 Red	8ES18 Green	9ES24 Red	10ES20 Yellow	ES-11-22 Yellow	ES-12-23 Red

Why this APG was not achieved:

The Earth Science Division (ESD) completed 80 percent of FY 2012 selections within 236 days, a small improvement from FY 2011's 240 days. The magnitude of solicitations, based on coverage of the diversity of scientific disciplines, and the number of proposals received continues to provide a challenge to meeting the targeted reductions. Additionally, staff workload is a factor. The small improvement was the result of the development of an integrated plan for the year ahead outlining the solicitations, the expected proposal numbers, and scheduling of review panels, while taking staffing into consideration. However, the planning effort was only starting to take effect in the selections for the current review cycle.

PERFORMANCE REPORTING AND PLANNING

Planned Annual Performance	
FY13 Update	No annual performance goal in FY13.
FY14	No annual performance goal in FY14.

Reported Annual Performance					
HE-12-6 Complete all development projects within 110 percent of the cost and schedule baseline.					
Contributing Theme:		Heliophysics			
Contributing Program(s):		Multiple Programs			
FY07	FY08	FY09	FY10	FY11	FY12
7ESS21 Yellow	8HE07 Red	9HE10 Yellow	10HE09 Red	HE-11-6 White	HE-12-6 Green

Planned Annual Performance	
FY13 Update	No annual performance goal in FY13.
FY14	No annual performance goal in FY14.

Reported Annual Performance					
HE-12-7 Deliver at least 90 percent of scheduled operating hours for all operations and research facilities.					
Contributing Theme:		Heliophysics			
Contributing Program(s):		Multiple Programs			
FY07	FY08	FY09	FY10	FY11	FY12
7ESS22 Green	8HE08 Green	9HE11 Green	None	HE-11-7 Green	HE-12-7 Green

Planned Annual Performance	
FY13 Update	No annual performance goal in FY13.
FY14	No annual performance goal in FY14.

Reported Annual Performance					
HE-12-8 Peer-review and competitively award at least 95 percent, by budget, of research projects.					
Contributing Theme:		Heliophysics			
Contributing Program(s):		Multiple Programs			
FY07	FY08	FY09	FY10	FY11	FY12
7ESS22 Green	8HE09 Green	9HE12 Green	None	HE-11-8 Green	HE-12-8 Green

Planned Annual Performance	
FY13 Update	No annual performance goal in FY13.
FY14	No annual performance goal in FY14.

PERFORMANCE REPORTING AND PLANNING

Reported Annual Performance					
HE-12-9 Reduce time within which 80 percent of NASA Research Announcement (NRA) grants are awarded, from proposal due date to selection, by four percent per year, with a goal of 180 days.					
Contributing Theme:		Heliophysics			
Contributing Program(s):		Multiple Programs			
FY07	FY08	FY09	FY10	FY11	FY12
7ESS24 Red	8HE10 Yellow	9HE13 Green	10HE12 Red	HE-11-9 Green	HE-12-9 Green

Planned Annual Performance	
FY13 Update	No annual performance goal in FY13.
FY14	No annual performance goal in FY14.

Reported Annual Performance					
PS-12-14 Complete all development projects within 110 percent of the cost and schedule baseline.					
Contributing Theme:		Planetary Science			
Contributing Program(s):		Multiple Programs			
FY07	FY08	FY09	FY10	FY11	FY12
7SSE10 Red	8PS09 White	9PS11 Red	10PS15 White	PS-11-14 Green	PS-12-14 Red
Why this APG was not achieved: NASA did not achieve this annual performance goal due to Mars Science Laboratory (MSL) cost growth that exceeded 10 percent of the estimated baseline at the Confirmation Review. MSL has demonstrated spectacular technical success, but it launched after a two-year delay and nearly 55 percent lifecycle cost growth from its originally confirmed baseline.					

Planned Annual Performance	
FY13 Update	No annual performance goal in FY13.
FY14	No annual performance goal in FY14.

Reported Annual Performance					
PS-12-15 Deliver at least 90 percent of scheduled operating hours for all operations and research facilities.					
Contributing Theme:		Planetary Science			
Contributing Program(s):		Multiple Programs			
FY07	FY08	FY09	FY10	FY11	FY12
7SSE11 Green	8PS10 Green	9PS12 Green	10PS16 Green	PS-11-15 Green	PS-12-15 Green

Planned Annual Performance	
FY13 Update	No annual performance goal in FY13.
FY14	No annual performance goal in FY14.

PERFORMANCE REPORTING AND PLANNING

Reported Annual Performance					
PS-12-16 Peer-review and competitively award at least 95 percent, by budget, of research projects.					
Contributing Theme:		Planetary Science			
Contributing Program(s):		Multiple Programs			
FY07	FY08	FY09	FY10	FY11	FY12
7SSE12 Green	8PS11 Green	9PS13 Green	10PS13 Green	PS-11-16 Green	PS-12-16 Green

Planned Annual Performance	
FY13 Update	No annual performance goal in FY13.
FY14	No annual performance goal in FY14.

Reported Annual Performance					
PS-12-17 Reduce time within which 80 percent of NASA Research Announcement (NRA) grants are awarded, from proposal due date to selection, by four percent per year, with a goal of 180 days.					
Contributing Theme:		Planetary Science			
Contributing Program(s):		Multiple Programs			
FY07	FY08	FY09	FY10	FY11	FY12
7SSE13 Red	8PS12 Green	9PS14 Green	10PS14 Red	PS-11-17 Red	PS-12-17 Red
Why this APG was not achieved:					
The Planetary Science Division completed 80 percent of their selections within 258 days, which represented a significant improvement from the FY 2011 performance of 290 days. The division did not achieve further improvement due to uncertainty in what level of funds would be available for award. The division delayed selections until the uncertainty was resolved.					

Planned Annual Performance	
FY13 Update	No annual performance goal in FY13.
FY14	No annual performance goal in FY14.

ADDRESSING MANAGEMENT CHALLENGES AND IMPROVING PERFORMANCE

An essential phase in NASA's performance management cycle is to evaluate Agency performance against its plans. Managers assess performance throughout the year and pay particular attention when NASA's performance falls short of its goals. They seek explanations, develop plans to improve performance, and track results for as long as necessary. NASA leadership also evaluates trends across the portfolio of programs and over longer periods of time to identify and resolve persistent issues.

The Government Performance and Results Act Modernization Act of 2010 reinforced NASA's approach to performance management by introducing requirements for unmet program performance. Specifically, Congress required agencies and the Office of Management and Budget to provide analysis of trends in unmet performance targets. When a NASA program does not meet its commitment as stated in the annual performance plan, responsible program officials must explain the performance shortfall and provide an improvement plan for correcting the issue. This section provides the explanations and performance improvement plans for any unmet performance measures in FY 2012 and, where applicable, the link to the prior year's performance. For FY 2012, NASA discusses performance trends in the following categories:

- Cost and Schedule Performance,
- Commercial Spaceflight Development, and
- Diversity.

To provide better performance improvement plans, NASA assesses the explanations for unmet performance and looks for trends in root causes. The results of this root cause analysis inform senior management when crosscutting corrective actions are warranted. In addition, NASA uses information on management and performance challenges, as identified by NASA's Office of Inspector General (OIG) and the Government Accountability Office (GAO), to better understand root causes and to guide setting improvement plans.

ADDRESSING MANAGEMENT CHALLENGES AND IMPROVING PERFORMANCE

Addressing Management Challenges

The Agency relies on internal and external evaluations of its policies and performance to improve performance management. Three such external evaluations deliver valuable insight into areas for improvement:

- The GAO High Risk Series;
- GAO’s Major Management Challenges and Program Risks, also referenced as the Management and Performance Series; and
- OIG’s annual Letter on NASA’s Top Management and Performance Challenges.

While the individual GAO and OIG reports provide a snapshot of the challenges at one- to two-year intervals, NASA examined the topics highlighted in the reports over a longer timeframe for additional insight. NASA looked for trends in the GAO reports over a 20-year span and in the OIG reports a 12-year span (see Figure 3.1).

Figure 3.1: Trends in GAO High Risk and OIG Management Challenges, 1991-2012

Report Year	1991/1992	1993/1994	1995/1996	1997/1998	1999/2000	2001/2002	2003/2004	2005/2006	2007/2008	2009/2010	2011/2012
Financial Management	▲	▲	▲	▲	▲ ■	▲ ■	▲ ■	▲ ■	▲ ■	■	
Contract Management	▲	▲	▲	▲	▲ ■	▲ ■	▲ ■	▲ ■	▲ ■	▲ ■	▲ ■
Program and Project Management/Cost and Schedule Performance	▲	▲	▲	▲	▲ ■	▲ ■	▲	▲ ■	▲ ■	▲ ■	▲ ■
IT Governance and Security					■	■	■	■	■	■	■
Infrastructure and Facilities Management	▲	▲		▲			■		▲	■	■
Human Capital Management				▲		▲	▲	■	■	■	
Human Spaceflight Transition and Future								■	■	■	■
Safety and Mission Assurance					■	■	■	■	■		

Legend: ▲ – GAO High Risk/Major Management Challenges
 ■ – OIG Management Challenges

ADDRESSING MANAGEMENT CHALLENGES AND IMPROVING PERFORMANCE

NASA identified eight categories where GAO and OIG predominately highlighted challenges. The primary categories of interest to both sets of evaluators center on NASA's financial management, contract management, and program and project management, particularly in the area of cost and schedule estimation. In each of these categories, NASA has made significant progress at addressing the weaknesses as outlined by GAO and OIG, as discussed below.

FINANCIAL MANAGEMENT

NASA has made significant improvements to the integrity of its financial management systems, processes, and reports. In the early 1990s, GAO reported that NASA was not in compliance with the Chief Financial Officers Act of 1990 requirements for a single integrated financial management system, and had accounting systems that were costly and outdated. NASA accelerated its efforts to develop an integrated system, but experienced delays in development, along with financial controls and reporting challenges along the way. The Agency continued to address each of these challenges and overcame them in FY 2011 to achieve an unqualified audit opinion. In FY 2012, NASA focused on maintaining the unqualified opinion while improving efficiencies and reducing costs. For example, NASA reduced administrative spending on travel, printing, supplies, and advisory services. These savings, which are associated with the Administration's management agenda to "Promote Efficient Spending," enabled the Agency to increase funding for research and development contracts, facilities enhancements, and grants.

CONTRACT MANAGEMENT

NASA contracts over 80 percent of its budget to acquire goods and services. Hence, the Agency has invested a significant effort in developing robust processes and procedures that ensure a strategic approach to acquisition planning and contract management. The Agency continues to address challenges in acquisition management and to build on these processes and procedures. For example, NASA continues to improve its earned value management capabilities, which started with initial codification of contract management policies in 1999, and now includes an expansion of requirements to measure performance of in-house efforts. These improvements will provide a holistic picture of the Agency's projects, which include both contractor and civil servant work. NASA also instituted senior leadership forums to ensure that contracting approaches are reviewed as part of the Agency acquisition process, and that acquisition decisions are integrated with budget and strategic planning. NASA will continue efforts to improve contract management, and is revisiting the measures that are currently within the annual performance plan to further characterize and monitor progress in areas of challenge.

The third area of interest, program and project management, particularly in the area of cost and schedule estimation, is discussed in the "Highlighted Performance Trends" section.

OTHER CATEGORIES

NASA remains diligent in addressing any current challenges in the other five categories of interest: human capital management, infrastructure and facilities management, safety and mission assurance, human spaceflight transition and future directions, and information technology governance and security. Below is a brief discussion of the status of these categories.

ADDRESSING MANAGEMENT CHALLENGES AND IMPROVING PERFORMANCE

Human Capital Management

When GAO identified human capital management as a high-risk area, their concern was that Federal agencies were not strategically planning for their human capital needs. NASA has been off GAO's list since 2003/2004. Beginning in 2005/2006, OIG also identified Shuttle and Constellation workforce transition as a management challenge. To help with transition, OHCM provided a range of tools and assistance to civil servants and contractors, including job seeking training sessions, career counseling, retention pay, and workforce sharing. OIG removed Shuttle and Constellation workforce transition as a management challenge as of 2011/2012. In 2011, NASA's Office of Human Capital Management (OHCM) released its Workforce Plan, which ensures that OHCM's priorities are aligned with NASA's future directions.

Infrastructure and Facilities Management

For years, GAO and OIG have highlighted issues with aging and underutilized infrastructure at NASA, including the scheduling and funding of facilities maintenance and repair, and NASA continues to address these issues. In 2011, NASA began developing its first integrated, Agency-wide real property Master Plan. NASA intends to use the Plan to coordinate resources across the Agency, link real property needs with projected funding to support NASA programs and strategic objectives, and gain efficiencies by eliminating facilities that no longer benefit the Agency. The development of an Agency-wide Master Plan is the result of NASA's efforts to revise its facility strategy to reduce the Agency's infrastructure footprint. In response to the NASA Authorization Act of 2010, NASA prepared a strategy document that describes the facilities renewal approach adopted in 2009 by the Agency, known as the "similar/smaller strategy," with a goal to reduce each Center's current replacement value by 10 percent by 2020 and 15 percent by 2050. NASA continues efforts to identify and reduce the Agency's unneeded and duplicative research and development facilities.

Safety and Mission Assurance

In 2003, OIG reported the Space Shuttle as a material weakness after the Columbia accident on February 1, 2003, and identified a range of safety and management assurance management challenges that would hinder return to flight. NASA corrected these issues in 2005. As NASA worked to complete ISS and retire the Shuttle fleet, OIG noted the additional risks to people, equipment, and mission that would result from the associated schedule pressures, technical challenges, and budgetary constraints. OIG removed this area as a management challenge two years before NASA safely flew out the Shuttle manifest and retired the fleet.

Human Spaceflight Transition and Future Directions

Over the past four years, this category has included retiring the Shuttle fleet, utilizing ISS safely, obtaining commercial cargo and crew services to low Earth orbit, and developing the next-generation Space Launch System (SLS). In FY 2011, NASA flew the last Shuttle mission, delivering the last major ISS component, and retired the fleet, one year later than the planned target. NASA's focus is now on fully utilizing ISS. A significant factor in achieving this is the amount of time the crew can commit to research. NASA has increased average crew research time from 23.9 hours per week in 2010 to 35 hours per week in 2012.

ADDRESSING MANAGEMENT CHALLENGES AND IMPROVING PERFORMANCE

The need for domestic access to space places has placed emphasis on NASA's support for commercial space services. In FY 2012, the Commercial Orbital Transportation Services Program partner SpaceX conducted a demonstration flight to ISS and its first resupply mission. NASA continues to tackle the challenges of developing requirements and certifying vehicles, particularly for commercial crew transportation services. Additionally, NASA continues to develop new spaceflight capabilities to move beyond low Earth orbit, through the development of SLS and the Multi-Purpose Crew Vehicle (MPCV), expected to have their first uncrewed demonstration in 2017. As these systems successfully develop, NASA expects that this management challenges area will be retired.

Information Technology Governance and Security

Over the past five years, OIG issued 21 audit reports containing 69 IT-related recommendations. OIG investigators conducted more than 16 separate investigations of breaches to NASA networks, several of which resulted in the arrests of foreign nationals. To improve the Agency's capability to detect and respond to cyber attacks and unauthorized access to its computers, in November 2008 NASA created a single, Agency-wide computer security incident response capability. An August 2012 OIG audit determined that this was providing an effective system for managing and reporting most IT security incidents. In FY 2012, NASA's IT security program began providing full-disk encryption on notebook computers and other mobile computing devices distributed to employees, with the target of Agency-wide protection by March 31, 2013. The audit also provided recommendations for enhancing NASA's detection and prevention capabilities, and the Agency is in the process of implementing these recommendations. NASA will continue to show improvements into the future in this area.

ADDRESSING MANAGEMENT CHALLENGES AND IMPROVING PERFORMANCE

Highlighted Performance Trend: Cost and Schedule Performance

COST AND SCHEDULE CHANGES TO PROJECT BASELINES: PERFORMANCE IMPROVEMENTS SEEN

This section provides a detailed look at the cost and schedule performance of NASA's programs and projects, as demonstrated in the FY 2013 Major Program Annual Report (MPAR), which only includes projects in development with a lifecycle cost baseline of \$250 million or more, and through annual performance goals in the FY 2012 Agency Performance Report. It discusses progress and corrective actions that NASA has taken in response to growth in both cost and schedule baselines. NASA also provides evidence of improvement, demonstrating that Agency policies lead to cost and schedule performance that meets Agency commitments across its portfolio.

Taking Corrective Actions Has Led to Performance Improvements

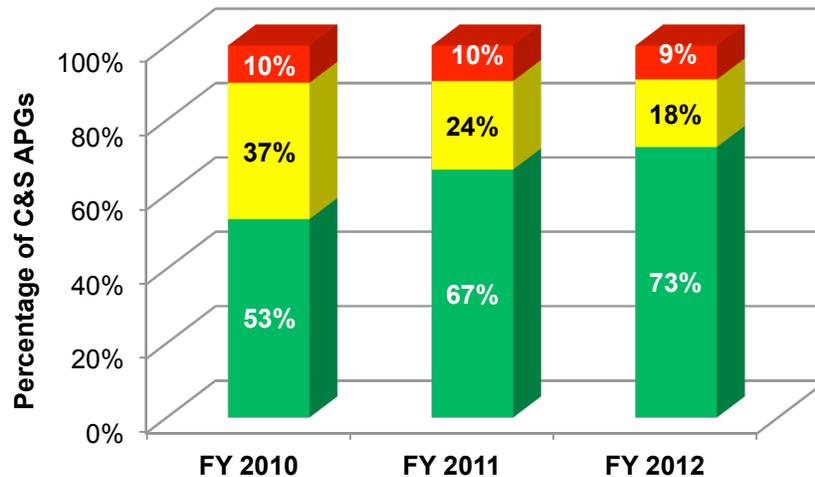
In the last five years, NASA fundamentally transformed how it manages its programs and projects, acquisition strategies, and procurements. This included strengthening program and project management, establishing more rigorous cost estimation practices, and revising procurement practices and systems. These efforts are now yielding demonstrated results for projects that were initiated under the new policies four to five years ago and have completed development in the last one to two years.

Trends in Annual Performance Goals Reflect Improvements

NASA established annual performance goals to measure cost and schedule performance. For example, the Agency created several measures that track completion of development projects to 10 percent over their cost and schedule baseline. Exceeding this threshold results in a rating other than Green. Figure 3.2 shows that over the last three fiscal years the number of cost and schedule annual performance goals (APGs) rated Yellow or Red has decreased, both in actual numbers and as a portion of the total number of APGs.

ADDRESSING MANAGEMENT CHALLENGES AND IMPROVING PERFORMANCE

Figure 3.2: Cost & Schedule APGs by Rating, FY 2010-FY 2012⁴



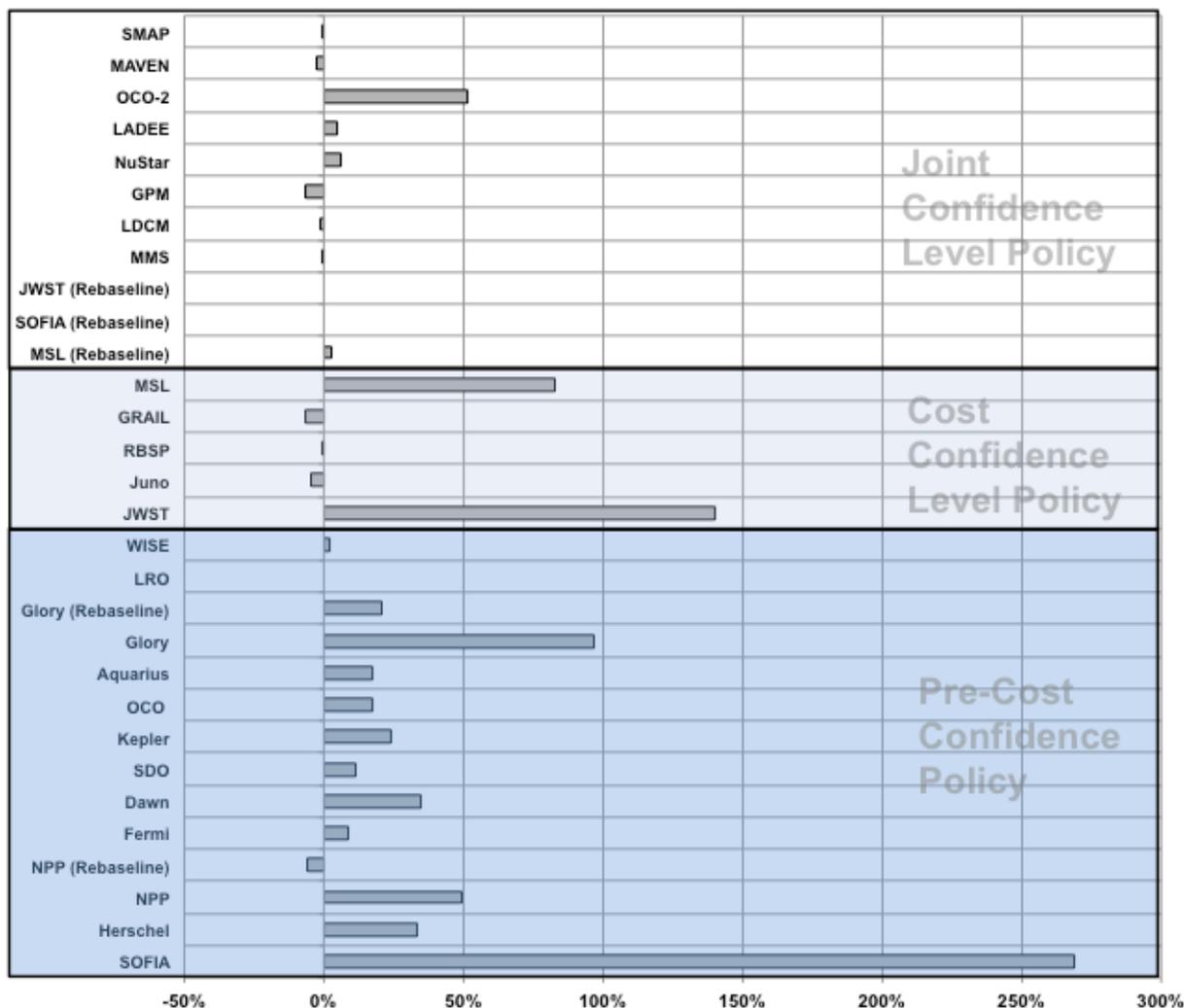
Changes to Cost and Schedule Estimating Policy Strengthened Performance

The Joint Confidence Level (JCL) policy has improved cost performance of NASA projects. NASA demonstrates the effectiveness of the new JCL policy by comparing the cost performance of projects confirmed using a JCL to projects confirmed under previous Agency policies, such as the Cost Confidence Level and Pre-Cost Confidence policies. Figure 3.3 shows that there is less variation from the estimated development cost baseline as NASA refined and implemented acquisition policies.

⁴ NASA revised the rating for OSIRIS-REx from White to Yellow after the Congressional Justification was printed. Therefore, this chart is different from the printed version.

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Figure 3.3: Cost Performance of NASA Projects Versus Cost and Schedule Estimating Policies⁵



Since mid-2011, six NASA missions (Juno, GRAIL, NPP, MSL, Van Allen Probes (formerly known as RBSP), and LDCM) launched without experiencing significant development cost growth from their Agency baseline commitments. All except NPP and MSL were launched under their original baseline budget. NASA confirmed NPP and MSL prior to many of the current program management improvements; adoption of these management practices as part of their rebaseline stabilized their cost performance.

⁵ NASA rebaselined the development costs of the NPP, Glory, MSL, SOFIA, and JWST projects. Figure 3.3 provides the cost changes from both the rebaseline and the original baseline, set at Key Decision Point-C. As reported in NASA's FY 2013 Congressional Budget Justification, due to a second Taurus-XL launch vehicle failure, NASA delayed the source selection and launch services preparations, integration, and testing for the OCO-2 project, resulting in a schedule delay and additional cost.

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Six space missions that remain in development are below the Congressionally prescribed fifteen percent cost threshold and six-month schedule threshold from their confirmation or rebaselined cost numbers; IRIS, LADEE, MAVEN, GPM, MMS, and JWST. OCO-2 is the single mission in development that has experienced cost growth since the FY 2013 Congressional Justification. The cost growth is due to selection of a more expensive and reliable launch vehicle, a NASA-directed change following two consecutive launch vehicle failures. While risks remain for all projects yet to launch, overall cost performance has prevented budgetary disruptions to other projects.

A History of Corrective Actions to Improve Cost and Schedule Performance

NASA's spaceflight projects are generally complex missions that require cutting edge scientific research and technology development. To effectively manage these acquisitions, NASA requires the integration of fundamental program and project management tools and sound acquisition practices. Ineffective project planning and controls can impact NASA's ability to understand and address challenges in a manner that either recognizes or mitigates cost and schedule growth. Specifically, effective lifecycle cost and schedule management requires:

- Instituting good lifecycle cost-estimating policy and processes (set good baselines);
- Instituting tracking and trending methodologies and using "best practice" tools to predict lifecycle estimate changes (proactively mitigate drift from and violation of the baseline);
- Establishing effective risk identification and planning for the costs to mitigate and deal with risks if they manifest (manage threats to lifecycle cost/schedule changes);
- Establishing clear reporting requirements and responsibilities (ensure accountability); and
- Making budget planning and allocation decisions based on lifecycle cost and schedule estimates and the performance toward these (ensure alignment of funding needs to lifecycle needs).

Since 2007, NASA has improved program and project management, lifecycle cost estimation, and procurement practices to address challenges in acquisition management. The Agency uses the information on management and performance challenges, including reports from the NASA OIG and GAO, to help guide these actions. Notable corrective actions include:

- Implementing new cost and schedule analysis and estimation processes, beginning with the Cost Analysis Data Requirement in 2005. In 2009, NASA introduced the use of an integrated probabilistic assessment of cost and schedule estimates, yielding a JCL;
- Revising Agency policy to identify and mitigate risks early in the formulation phase of a project to improve performance during the implementation phase, including establishment of the Formulation Agreement, development of Maturity Matrices, and a requirement to baseline some products earlier in the life cycle;
- Establishing a pilot program to address leading technical indicators to assess a project's maturity;
- Developing and implementing NASA Policy Directive 1000.5A, "Policy for NASA Acquisition," in 2008 to provide a framework to link budget decisions to achieving specified confidence levels for lifecycle cost and schedule baselines;
- Instituting senior leadership forums to ensure the Agency acquisition process is integrated with budget and strategic planning. These forums are the Strategic Implementation Planning meeting

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and the Acquisition Strategy Meeting, as well as the redefined existing Procurement Strategy Meeting; and,

- Improving NASA's earned value management capabilities.

Two of the corrective actions are discussed in more detail below.

Improvements to Cost and Schedule Estimating Policy

Estimating cost and schedule baselines for NASA projects is complex and challenging. NASA must account for risks introduced by many factors. Factors in the industrial base include launch vehicle availability, vendor capabilities, and counterfeit parts. Long development cycles can be affected by factors such as instability of funding, delays in funding, or a misalignment of resources and schedules. Acquisition management introduces additional risk factors, such as protests on a vendor award, to project cost and schedule baselines. Ineffective project planning and controls can impact the ability to understand these factors and to address them in a manner that mitigates cost and schedule growth. Project risks, if realized, can contribute to cost and schedule growth.

In January 2009, NASA strengthened estimation practices by adopting a new acquisition strategy policy, which improves the Agency's ability to manage performance risk. The new policy requires space flight projects and programs to develop JCLs that address both cost and schedule risks. A JCL builds on traditional cost and schedule estimating practices by providing a probability that a project will meet its cost and schedule targets. The policy requires a JCL to inform NASA's baseline commitments. As NASA has become more experienced in using JCLs, it is modifying its processes to utilize this management tool for projects with lifecycle costs greater than \$150 million (currently, only projects with lifecycle costs of \$250 million or more are required develop JCLs as part of their management strategy). Additionally, the policy requires separate probabilistic range estimates for cost and schedule at an early key decision point to support adequate long-term budget planning.

Mitigating Risks in the Project Formulation Phase

During the formulation phase, key decisions are made that will affect a project through development and operations. NASA is mitigating risks during the formulation phase by formalizing project parameters and addressing technical maturity. NASA is revising its policy to require a formulation agreement, which ensures stakeholders have a clear understanding of the work to be performed with associated cost and schedule requirements. Such an agreement was not typically required until a project entered the development phase.

Additionally, NASA has focused on adequate technical maturity, not only in support of preliminary design reviews, but also throughout the life cycle. The Agency recognizes that sufficient technical maturity is essential to improve cost estimation during the formulation phase and to set robust cost and schedule baselines for the development phase.

In response to direction regarding "Cost Control" in House Report 112-169, accompanying the NASA FY 2012 appropriation (H.R. 2596), NASA is codifying an approach to ensure appropriate technical maturity in NASA's program and project management policies in the NASA Procedural Requirements (NPR) 7123, "NASA Systems Engineering Processes and Requirements." Specifically, the Agency

ADDRESSING MANAGEMENT CHALLENGES AND IMPROVING PERFORMANCE

created a set of “Maturity Matrices” that clarify expected design maturity objectives at lifecycle reviews and key decision points. NASA has established and is piloting a set of technical leading indicators for both the preliminary design review and the critical design review to enhance leadership’s understanding of the project’s maturity. Finally, NASA currently is developing a common set of programmatic and technical indicators to support trending analysis of the design maturity throughout the life cycle. NASA included the indicators in the Program and Project Plan templates found in the appendix of NPR 7120.5, “NASA Space Flight Program and Project Management Requirements.”

FY 2012 COST AND SCHEDULE PERFORMANCE DETAILS AND TRENDS

2013 Major Program Annual Report Summary

The 2013 MPAR is provided to meet the requirements of section 103 of the NASA Authorization Act of 2005 (P.L. 109-155; 42 U.S.C. 16613). The 2013 MPAR consists of this summary and FY 2014 Congressional Justification pages designated as “Projects in Development,” for the projects outlined below. These project pages constitute each project’s annual report, or if this is the first year for which it is in reporting, the baseline report. The MPAR summary also includes the confidence level of achieving the commitments as requested in the Conference Report accompanying the FY 2010 Consolidated Appropriations Act (P.L. 111-117). As required by section 1203 of NASA 2010 Authorization Act (P.L. 111-267; 42 U.S.C. 18301), the corrective action plans for GPM, OCO-2, JWST and SOFIA can be found in the respective project pages in the FY 2014 Congressional Justification.

Changes in MPAR Composition since the FY 2013 NASA Budget Estimates

Two new projects with estimated lifecycle costs greater than \$250 million received authority to proceed into the development phase since NASA submitted its 2012 MPAR in the FY 2013 NASA Congressional Justification:

- ICESat-2, with a baseline development cost of \$558.9 million at a joint confidence level of 70 percent; and
- SMAP, with a baseline development cost of \$485.7 million and a greater than 70 percent joint confidence level.

The 2012 MPAR in the FY 2013 NASA Congressional Justification included two projects that are no longer in MPAR reporting. NASA successfully launched the Van Allen Probes (formerly known as RBSP) spacecraft on August 30, 2012, and the LDCM spacecraft on February 11, 2013. NASA launched the Van Allen Probes within three months of the project baseline launch date and below the baseline development cost. NASA launched LDCM four months before the project baseline launch date and below the baseline development cost.

There are no other changes to the MPAR composition to report. Refer to Figure 3.4 for the full list of reportable projects.

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Changes in Cost and Schedule Estimates from the 2012 MPAR

No projects exceeded a cost or schedule threshold since the 2012 MPAR. This report includes updates to the OCO-2 project cost and schedule, previously reported as “under review” due to uncertainty regarding which launch vehicle NASA would use for the mission. NASA completed the threshold reporting requirements for the GPM project, which resulted from the project’s schedule delay, and submitted the reports to the White House and appropriate Congressional committees.

MPAR Summary Table

Figure 3.4 provides cost, schedule, and confidence level information for NASA projects currently in development with lifecycle cost estimates of \$250 million or more. NASA records the estimated development cost and a key schedule milestone and then measures changes from them. NASA tracks one of several key milestones, listed below, for reporting purposes:

- Launch Readiness Date (LRD);
- Full Operational Capability (FOC); or
- Initial Operating Capability (IOC).

As a note for clarification, LRDs are not typically the launch dates on the NASA launch manifest, but are the desired launch dates as determined by the payload mission and approved by the NASA Flight Planning Board (FPB). A launch manifest is a dynamic schedule that is affected by real world operational activities conducted by NASA and multiple other entities. It reflects the results of a complex process that requires the coordination and cooperation by multiple users for the use of launch range and launch contractor assets. The launch dates shown on the NASA FPB launch manifest are a mixture of confirmed range dates for missions launching within approximately six months and contractual/planning dates for the missions beyond six months from launch. The NASA FPB launch manifest date is typically earlier than the reported schedule date, thereby allowing for the operationally driven fluctuations to the launch schedule that may be outside of the Project’s control. The NASA FPB launch manifest is updated on a periodic basis throughout the year.

The confidence level (CL) estimates reflect an evolving process as NASA improves its probabilistic estimation techniques and processes. Each estimate reflects the practices and policies at the time it was developed. Estimates that include combined cost and schedule risks are denoted as Joint Confidence Level (JCL) estimates; all other CLs reflect cost confidence without necessarily factoring the potential impacts of schedule changes on cost.

Additional explanations for the data in the summary table are provided here:

- The joint confidence level percentage for GPM reflects the KDP-C Replan JCL, approved in October 2011.
- The FY 2013 Congressional Justification established the JWST rebaseline, which is reflected in the table below. JWST’s MPAR Cost Estimate includes Construction of Facilities funds.
- For MMS, the confidence level estimates include the partners’ contributions, while the development cost reflects only the NASA portion of project costs.

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- MAVEN’s JCL included schedule risk of the launch vehicle but used the Headquarters-provided launch vehicle cost as a pass-through number per agreement with the Standing Review Board (SRB).
- The current year development cost and key milestone date for OCO-2 would become the new project baseline after Congressional reauthorization pursuant to sec. 103 of P.L. 109-155. The JCL was performed for Phases C and D, excluding project managed unallocated future expenses, JPL fees, launch services, and low-level fixed cost activities at GSFC.
- The confidence level estimate performed for TDRS K/L addresses the full partner contribution, while the development cost reflects only the NASA portion of project costs. The current baseline costs are solely for TDRS K/L.

Additional information on the projects shown in the table below can be found in their individual program and project pages in the main body of the Congressional Justification.

Figure 3.4: MPAR Summary and Confidence Levels

Project	Base Year	JCL (%)	Development Cost Estimated (\$M)		Cost Change (%)	Key Milestone	Key Milestone		Schedule Change (months)
			Base	2013			Base	2013	
GPM	2010	70	555.2	509.3	-8.3	LRD	Jul 2013	Jun 2014	11
ICESat-2	2013	70	558.9	556.5	-0.4	LRD	May 2017	May 2017	0
JWST	2012	66	6,197.9	6,190.4	-0.1	LRD	Oct 2018	Oct 2018	0
LADEE	2011	70	168.2	176.1	4.7	LRD	Nov 2013	Nov 2013	0
MAVEN	2011	70	567.2	550.5	-3.0	LRD	Nov 2013	Nov 2013	0
MMS	2010	70	857.3	856.8	-0.1	LRD	Mar2015	Mar 2015	0
OCO-2	2011	70	249.0	371.6	49.2	LRD	Feb 2013	Feb 2015	24
SMAP	2013	>70	485.7	484.8	-0.2	LRD	Mar 2015	Mar2015	0
SOFIA	2007	70	919.5	1,127.8	22.7	FOC	Dec 2013	Dec 2014	12
TDRS K/L	2010	75 (CL)	209.4	184.6	-11.8	LRD	K: Dec 2012	K: Jan 2013	1
							L: Dec 2013	L: Feb 2014	2

COST AND SCHEDULE ANNUAL PERFORMANCE GOALS

NASA reviewed its annual performance measures where performance fell short due to cost and schedule issues. In FY 2010, 14 APGs indicated cost or schedule growth in NASA’s projects. In FY 2011, there were seven. As of FY 2012, there were only five such APGs. Root causes presented in these tables include development partner challenges, vendor quality parts and processes, launch vehicles, funding instability, program planning and control, and acquisition management.

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10IT11	
Accountable Organization: Office of the Chief Information Officer	
Complete all development projects within 110% of the cost and schedule baseline.	FY 2010 Red
Why Measure 10IT11 Was Not Met: All but one project finished within the required 110 percent of cost and schedule baselines. The Security Operations Center (SOC) implementation (Phase-2) project has undergone schedule slips, due to delays in facilities power modifications resulting in delays of receiving IT Security event data from numerous sources across the Agency. The delay in having adequate power to the facility kept the SOC from being able to capture data, thereby not allowing testing and not being ready to complete the ORR. The extra power lines and resultant coordination were not planned for when the project was initially scoped and were beyond the initial project plan estimates. The final SOC implementation plan will increase cost to 145 percent and schedule to 161 percent of the initial project scope. NASA reviewed this project during implementation, and given the importance of IT security, approved additional time and funding for the project.	
FY 2010 Performance Improvement Plan: There are no options to achieving this goal. NASA determined the IT Security Operations Center project implementation fits into the CyberSecurity scope and needed to be accomplished to protect NASA's IT vulnerability.	
10HE09	
Accountable Organization: Science Mission Directorate, Heliophysics Division	
Complete all development projects within 110% of the cost and schedule baseline.	FY 2010 Red
Why Measure 10HE09 Was Not Met: NASA did not complete the Solar Dynamics Observatory (SDO) within 110 percent of cost and schedule baselines. SDO initially slipped from its 2008 firm slot in the launch manifest due to late delivery of avionics boxes and instruments and problems with electronics parts and the high-speed data bus. SDO then experienced difficulty obtaining a new slot in the launch manifest, as no firm slots were available until 2010 due to multiple Atlas V launch vehicle issues and associated launch queue delays.	
FY 2010 Performance Improvement Plan: NASA launched SDO in February 2010. This exceeded the original schedule by 48 percent, but the mission's lifecycle cost remains within seven percent of the original cost baseline.	
10ES17	
Accountable Organization: Science Mission Directorate, Earth Science Division	
Complete all development projects within 110% of the cost and schedule baseline.	FY 2010 Red
Why Measure 10ES17 Was Not Met: NASA did not complete the Glory and Aquarius missions within 10 percent of their cost and schedule baselines.	
FY 2010 Performance Improvement Plan: The Glory mission experienced significant cost and schedule growth due primarily to the failure of the Orbiting Carbon Observatory (OCO) Taurus XL launch vehicle and issues with the vendor's production of acceptable boards for the Maxwell Single Board Computers. Glory's current projected lifecycle cost is 68 percent higher than the baseline established at Confirmation Review. The mission is tentatively scheduled for a February 2011 launch readiness date, a 72 percent increase in schedule. The Aquarius launch readiness date has been rescheduled for April 2011 due to delays in the development of the international partner's Mission Operations System. The schedule for the mission has increased by 60 percent, but the lifecycle cost remains within 15 percent of the baseline. ⁶	

⁶ In March 2011, Glory was lost due to a failure of the Taurus XL launch vehicle. Aquarius launched in June 2011.

ADDRESSING MANAGEMENT CHALLENGES AND IMPROVING PERFORMANCE

ES-11-19 (Efficiency Measure)	
Accountable Organization: Science Mission Directorate, Earth Science Division	
Complete all development projects within 110 percent of the cost and schedule baseline.	FY 2011 Red
<i>Why Measure ES-11-19 Was Not Met:</i> This annual performance goal was not met, due to cost and schedule growth that exceeded 10 percent of their estimated baseline for the NPOESS Preparatory Project (NPP), Glory, and Aquarius missions. The NPP mission experienced delays due to the restructure of the project management and on-going development issues with an instrument, contributed by one of NASA's partners. The Aquarius mission was delayed by NASA's international partner, after the successful delivery of NASA's instrument contribution. The Glory mission had both instrument and spacecraft technical issues, across its development.	
<i>FY 2011 Performance Improvement Plan:</i> NASA's new 70 percent CL requirements include consideration of the risks of partnership. These and other procedures subsequently put in place are improving cost and schedule performance.	
ES-12-20 (Efficiency Measure)	
Accountable Organization: Science Mission Directorate, Earth Science Division	
Complete all development projects within 110 percent of the cost and schedule baseline.	FY 2012 Red
<i>Why Measure ES-12-20 Was Not Met:</i> NASA did not achieve this annual performance goal due to cost and schedule growth that exceeded 10 percent of the estimated baseline for the NPOESS Preparatory Project (NPP), which launched in FY 2012. The NPP project experienced delays due to on-going development issues with instruments provided by NASA's government partners.	
<i>FY 2012 Performance Improvement Plan:</i> NASA successfully launched the NPP spacecraft on October 28, 2011, ending the project's development phase. No further performance improvement activities are necessary.	
PS-12-14 (Efficiency Measure)	
Accountable Organization: Science Mission Directorate, Planetary Science Division	
Complete all development projects within 110 percent of the cost and schedule baseline.	FY 2012 Red
<i>Why Measure PS-12-14 Was Not Met:</i> NASA did not achieve this annual performance goal due to Mars Science Laboratory (MSL) cost growth that exceeded 10 percent of the estimated baseline at the Confirmation Review. MSL has demonstrated spectacular technical success, but it launched after a two-year delay and nearly 55 percent lifecycle cost growth from its originally confirmed baseline.	
<i>FY 2012 Performance Improvement Plan:</i> MSL launched on November 26, 2011, ending the project's development phase. The Curiosity rover has been successfully operating on Mars since August 6, 2012. NASA's risk-based approach to budgeting and planning has proven to be successful, as evidenced by cost and schedule performance on the Juno and GRAIL missions. These missions, which also launched in FY 2012, remained within their cost and schedule baselines. No further performance improvement activities are necessary.	
AS-12-6 (Efficiency Measure)	
Accountable Organization: Science Mission Directorate, Astrophysics Division	
Complete all development projects within 110 percent of the cost and schedule baseline.	FY 2012 Yellow
<i>Why Measure AS-12-6 Was Not Met:</i> NASA did not achieve this annual performance goal due to schedule growth that exceeded 10 percent of the estimated baseline at the Confirmation Review. The NuSTAR project realized 17	

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percent schedule growth due to delays in the launch provider's validation of flight software associated with the new launch vehicle flight computer and subsequent launch site availability issues. Based on these factors, the NuSTAR launch slipped from March to June 2012. Project costs, however, remained well within the threshold, at three percent growth from the confirmed baseline.	
FY 2012 Performance Improvement Plan: The NuSTAR spacecraft successfully launched on June 13, 2012, ending the project's development phase. No further performance improvement activities are necessary.	

Development Partner Challenges	
10ES02	
Accountable Organization: Science Mission Directorate, Earth Science Division	
Develop missions in support of this Outcome, as demonstrated by completing Aquarius Operational Readiness Review (ORR).	FY 2010 Yellow
Why Measure 10ES02 Was Not Met: Due to delays in the development of the international partner's Mission Operations System, the ORR was not completed in FY 2010.	
FY 2010 Performance Improvement Plan: A specific date has not been identified, but NASA estimates this to be in early 2011. However, any delays to the overall mission schedule could cause the ORR to move further.	
FY 2011 Update: The Aquarius Operational Readiness Review was completed April 28, 2011.	

Vendor Quality, Parts, and Processes	
10ES21	
Accountable Organization: Science Mission Directorate, Earth Science Division	
Develop missions in support of this Outcome, as demonstrated by completing the Pre-Ship Comprehensive Performance Test for Glory.	FY 2010 Yellow
Why Measure 10ES21 Was Not Met: The Glory Pre-Ship Comprehensive Performance Test began on September 17, 2010, but was not completed until October 4, 2010. The test was delayed primarily due to resolution of spacecraft hardware anomalies.	
FY 2010 Performance Improvement Plan: The test was completed successfully on October 4, 2010.	
10AS07	
Accountable Organization: Science Mission Directorate, Astrophysics Division	
Develop missions in support of this Outcome, as demonstrated by completing the first competed Early Science observations on the Stratospheric Observatory for Infrared Astronomy (SOFIA).	FY 2010 Yellow
Why Measure 10AS07 Was Not Met: Technical problems with the telescope cavity door actuator on the SOFIA aircraft, due to quality control issues at the vendor of the actuator, led to increased time required for flight testing and certification for open-door flight at the altitude required for Early Science. NASA worked directly with the vendor to address and resolve the quality control issues.	
FY 2010 Performance Improvement Plan: Flight testing of the full flight envelope has been completed, and the first image has been acquired by the telescope in flight. The program is currently on track for the first Early Science observation by December 2010.	

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<p>FY 2011 Update: SOFIA completed the first of three science flights on Wednesday, December 1, 2010.</p>	
<p>ES-11-3 (Performance Goal 2.1.1.2)</p>	
<p>Accountable Organization: Science Mission Directorate, Earth Science Division</p>	
<p>Initiate the Orbiting Carbon Observatory-2 (OCO-2) Instrument and Spacecraft System-Level Testing.</p>	
<p>Why Measure ES-11-3 Was Not Met: The OCO-2 instrument system-level testing was scheduled to begin in August 2011, but has been delayed to October due to technical issues. Technical issues included a coating adhesion issue on multiple parts that was introduced by contamination during the vendor's process, and a misalignment along an optical path on the instrument, which was seen during vibration testing and could impact performance. Additionally, the spacecraft-level system testing is scheduled to begin in December 2011, due to late deliverables from subsystem vendors. At this time, the overall delivery of the spacecraft remains unchanged for March 2012, but the instrument delivery has been delayed by one month to April 2012, and NASA continues to work with its vendors to address these issues and prevent further delays.</p>	
<p>FY 2011 Performance Improvement Plan: To address the coating adhesion issue, a decision was made to proceed with an alternate vendor and process (black anodizing) for the parts. The change was implemented and all parts now meet specification. Additionally, the optical path misalignment issue was addressed and appears to be resolved, but it will remain open until confirmed during instrument-level vibration testing (scheduled for December 2011). These two issues have resulted in an approximately a one month delay in delivery of the instrument (now April 2012). This delay is not expected to impact the overall delivery schedule of the observatory or the launch readiness date (LRD). The Spacecraft System-Level Testing has been scheduled for December 2011 due to the late subsystem vendor deliveries. However, the spacecraft remains on plan to be delivered in March 2012, with no impact to the launch readiness review.</p>	<p>FY 2011 Yellow</p>
<p>FY 2012 Update: NASA completed the OCO-2 Systems Integration Review, which signifies the beginning of the testing and integration phase of spacecraft development, in May 2012. System-level testing for the OCO-2 instrument and spacecraft both began in FY 2012. NASA completed instrument system-level testing and continues spacecraft system-level testing. The mission is on track for launch in 2014.</p>	
<p>ES-11-6 (Performance Goal 2.1.2.2)</p>	
<p>Accountable Organization: Science Mission Directorate, Earth Science Division</p>	
<p>Complete the Global Precipitation Measurement (GPM) Systems Integration Review</p>	
<p>Why Measure ES-11-6 Was Not Met: Both the NASA spacecraft and instrument developments are experiencing challenges in subsystem deliveries. These development challenges are resulting from various issues including defects discovered in flight parts, component manufacturing throughput issues and workmanship issues at supply vendors. In addition, the delivery of the Japan Aerospace Exploration Agency (JAXA)-provided Dual-frequency Precipitation Radar (DPR) instrument has been delayed due to disruptions at, and damage to, the test facility resulting from the March 2011 earthquake. Technical issues with the DPR were also identified during environmental testing. It is currently estimated that these challenges will result in a launch readiness delay of eleven months, from July 2013 to June 2014.</p>	
<p>FY 2011 Performance Improvement Plan: NASA and JAXA are working together to replan the program to accommodate these delays. NASA and JAXA have taken actions that include implementing extended shifts/weekend work and integration and testing workarounds (for NASA, the use of engineering test units in place of flight subsystems) to recover schedule where feasible. Completion of the Systems Integration Review is scheduled for the second quarter of FY 2012.</p>	<p>FY 2011 Yellow</p>
<p>FY 2012 Update: NASA completed the GPM Systems Integration Review in February 2012, and as of December 2012, the integrated spacecraft was in system-level thermal vacuum testing. The mission is on track for launch in 2014.</p>	

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Launch Vehicle Availability &and Reliability/Manifest Issues	
10ES10	
Accountable Organization: Science Mission Directorate, Earth Science Division	
Develop missions in support of this Outcome, as demonstrated by completing the SMAP Preliminary Design Review (PDR).	FY 2010 Yellow
<i>Why Measure 10ES10 Was Not Met:</i> The Soil Moisture Active and Passive (SMAP) mission PDR is currently scheduled for March 2011, consistent with the schedule presented at the mission's Initial Confirmation Review.	
<i>FY 2010 Performance Improvement Plan:</i> Currently, all pre-cursor events (i.e., peer reviews, sub-system PDRs) are proceeding on or ahead of plan. However, a launch vehicle has not yet been selected for SMAP, and this could impact the scheduling of PDR. NASA is addressing this issue, but it is not expected to be resolved until after March.	
<i>FY 2011 Update:</i> The Preliminary Design Review for the SMAP mission occurred in October 2011.	
ES-11-10 (Performance Goal 2.1.4.2)	
Accountable Organization: Science Mission Directorate, Earth Science Division	
Complete the Soil Moisture Active-Passive (SMAP) Confirmation Review.	FY 2011 Yellow
<i>Why Measure ES-11-10 Was Not Met:</i> The SMAP Confirmation Review was delayed to FY 2012 because of difficulties in identifying an acceptable launch vehicle for the mission. NASA's Earth Science program has been impacted by the current limited availability of launch vehicles in the medium size range that is appropriate for most of its missions.	
<i>FY 2011 Performance Improvement Plan:</i> The SMAP Confirmation Review has been rescheduled until the second quarter of FY 2012. The Science Mission Directorate (SMD) plans to conduct a Directorate-level Program Management Council (DPMC) review in November 2011 to assess project status and establish near-term observatory development guidelines and constraints following the recent Preliminary Design Review. To conduct PDR, SMD management requested the project assume use of a Minotaur IV+ launch vehicle. This DPMC will also assess a plan to establish a project baseline cost and schedule, that is independent of a confirmed launch vehicle (which is not expected until mid 2012). This plan forward will consider analysis of observatory design, cost and schedule risks, and any additional required reviews. In parallel with these activities, SMD will continue to work with the Human Exploration and Operations Directorate to pursue launch vehicle options for SMAP.	
<i>FY 2012 Update:</i> NASA completed the SMAP Confirmation Review in May 2012.	
Funding Instability and Limitations	
ES-11-14 (Performance Goal 2.1.5.3)	
Accountable Organization: Science Mission Directorate, Earth Science Division	
Complete the ICESat-2 Spacecraft System Requirements Review.	FY 2011 Yellow
<i>Why Measure ES-11-14 Was Not Met:</i> The date for the ICESat-2 Spacecraft Systems Requirements Review has been delayed to December 2011. This review was rescheduled from March 2011 to revisit the mission design and requirements to align with the estimated available budget, moving forward.	

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<p>FY 2011 Performance Improvement Plan: The mission design and requirements have been revised to align to the available funds. As part of the realignment, the mission is moving forward based on a co-manifested launch solution, with shared launch costs, with the Air Force. The Spacecraft System Requirements Review is scheduled for December 2011. The mission's baseline plan is to be manifested with the Defense Meteorological Satellite Program Flight-20 (DMSP F-20) on an Atlas V launch vehicle that has already been purchased by the U.S. Air Force (USAF). NASA will be responsible for funding the Dual Spacecraft System (DSS) development and flight unit qualification. The DSS will represent a new capability for U.S. Government payloads using the EELV launch system. The USAF will procure the launch service and provide overall mission assurance related to the launch vehicle and dual payload accommodation. This interagency arrangement provides significant cost savings for NASA, allowing the mission to proceed within its allocated budget.</p>	
<p>FY 2012 Update: NASA completed the ICESat-2 System Requirements Review in January 2012. Subsequently, the Air Force determined that they would not be able to proceed with the planned partnership. NASA made the necessary program adjustments to provide the funding for the procurement of a dedicated launch vehicle, which was to have been contributed in the partnership.</p>	
<p>ES-12-13 (Performance Goal 2.1.5.3)</p>	
<p>Accountable Organization: Science Mission Directorate, Earth Science Division</p>	
<p>Complete the Ice, Cloud, and Land Elevation Satellite-2 (ICESat-2) Preliminary Design Review.</p>	<p>FY 2012 Yellow</p>
<p>Why Measure ES-12-13 Was Not Met: NASA delayed the date for the ICESat-2 Preliminary Design Review from July 2012 to October 2012 so the project could revisit the mission design and requirements in order to align with the estimated available budget, moving forward in fiscal years 2014 and 2015.</p> <p>The ICESat-2 project has received three Yellow ratings during the four years it has been in performance review. The project has received all of these during its formulation phase. The first Yellow rating occurred early in the project's formulation, when the Earth Systematic Missions Program was conducting the advanced concepts study. The other two Yellows have been the result of NASA's difficulty in acquiring a launch vehicle. This challenge has resulted in changes to the project budget and schedule delays. NASA remains dedicated to the ICESat-2 project because the spacecraft will be an integral part of NASA's Earth-observation fleet of satellites. It will provide estimates of ice sheet thickness and help scientists determine ice sheet contributions to recent sea level change. The first mission, ICESat, successfully completed operations in 2009, and NASA has been conducting observations from aircraft, through the IceBridge project, in the interim between ICESat missions.</p>	
<p>FY 2012 Performance Improvement Plan: NASA completed the preliminary design review in October 2012. Mission confirmation followed in December by mission confirmation, which established a baseline cost and schedule commitment. No further performance improvement activities are necessary.</p>	

<p>Program Planning and Controls</p>	
<p>10IT06</p>	
<p>Accountable Organization: Office of the Chief Information Officer</p>	
<p>Complete Operational Readiness Review (ORR) for the NASA Security Operations Center.</p>	<p>FY 2010 Red</p>
<p>Why Measure 10IT06 Was Not Met: The Security Operations Center (SOC) Implementation Project was scheduled to have the ORR this year, but has undergone schedule slips due to delays in facilities power modifications and further delays in receiving IT Security data from numerous sources across the Agency. These delays have negated the ability to complete the testing required in preparation of the Operational Readiness Review.</p>	

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<p>FY 2010 Performance Improvement Plan: The SOC Implementation Project will move forward with IT Security event data collection in fall 2010. As the data is obtained, the project will complete final system integration and validation testing. Upon completing validation testing and user training the project will precede to ORR currently scheduled for November FY 2011.</p>	
<p>FY 2011 Update: The SOC ORR was completed March 2011.</p>	
10SFS07	
Accountable Organization: Space Operations Mission Directorate, Space and Flight Support	
<p>Complete TDRS K/L Project Mission Operations Review (MOR).</p>	FY 2010 Yellow
<p>Why Measure 10SFS07 Was Not Met: The TDRS project had originally scheduled the K/L MOR for September 2010 but was delayed to resolve minor conflicts involving resources.</p>	
<p>FY 2010 Performance Improvement Plan: The MOR will be held in November 2010.</p>	
<p>FY 2011 Update: The Mission Operations Review was held in November 2010.</p>	
10PS06	
Accountable Organization: Science Mission Directorate, Planetary Science Division	
<p>Develop missions in support of this Outcome, as demonstrated by completing the Mars Science Laboratory (MSL) flight hardware builds and flight system assemblies.</p>	FY 2010 Yellow
<p>Why Measure 10PS06 Was Not Met: The flight hardware build and flight system assembly of the Sample Analysis at Mars (SAM) instrument were not completed during the designated fiscal year, due to complications in the development of the Wide Range Pump (WRP) components of the instrument. The materials originally specified as the primary component of a high-speed, high-performance bearing proved to be inadequate to provide the necessary performance on the surface of Mars, and alternative bearing materials and components had to be researched and developed.</p>	
<p>FY 2010 Performance Improvement Plan: The development of the new bearing designs has been completed and implemented, and the finalization of the flight hardware build has resumed. The final flight units are on schedule to be delivered in early December 2010.</p>	
<p>FY 2011 Update: The work was completed by redesigning the primary bearings on the pump from alternate materials that provided the required performance for the Mars environment. Design, fabrication, testing, validation, and installation of the new bearings were completed according to the revised schedule. The pump was completed and delivered to the flight project as scheduled in December 2010.</p>	
Performance Goal 2.4.2.2	
Accountable Organization: Science Mission Directorate, James Webb Space Telescope Program	
<p>Design and assemble James Webb Space Telescope (JWST).</p>	FY 2011 Yellow
<p>Why Performance Goal 2.4.2.2 Was Not Met: The measure was placed in the FY 2012 Congressional Justification prior to the project's replan. Based on this, the baseline assumption for the measure was that the project was still operating under the original baseline. The new estimated baseline, which was approved late in the fiscal year, resulted in a 78% increase in the estimated life cycle cost from the original baseline. The new estimated baseline has been endorsed by the NASA Administrator, all reporting required by Section 103 of the NASA Authorization Act of 2005 has been completed, and 95% of the FY 2011 planned activities were accomplished, indicating that it is likely to stay on track for the new estimated cost. Specifically, JWST achieved 19 of its 21 planned FY 2011</p>	

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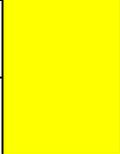
<p>milestones on or ahead of schedule, one milestone was achieved one month late and one milestone was delayed due to design changes, and is on track to achieve its FY 2012 milestones. The one planned FY 2011 milestone that was achieved a month late and the one that has been delayed do not impact the critical path.</p>	
<p>FY 2011 Performance Improvement Plan: NASA has taken many steps to address the challenges seen on the JWST Project. In FY 2010, an independent panel concluded that the problems causing cost growth and schedule delays on the JWST project were associated with cost estimation and program management. To address these, NASA made several important changes in JWST program and project management and in the interaction with the prime contractor. All the JWST senior management at both Headquarters and at Goddard Space Flight Center have been replaced. The program has been taken out of the Astrophysics Division and now reports programmatically to the NASA Associate Administrator, and is an Agency priority. NASA also embarked on revising the cost and schedule estimates. The replanning activity is complete, has been approved within the Agency. The Agency will continue to monitor the progress on the development of this project, as highlighted above.</p>	
<p>FY 2012 Update: Not applicable.</p>	
<p>ES-12-5 (Performance Goal 2.1.2.2)</p>	
<p>Accountable Organization: Science Mission Directorate, Earth Science Division</p>	
<p>Complete the Global Precipitation Measurement (GPM) Pre-Environmental Review.</p>	
<p>Why Measure ES-12-5 Was Not Met: The GPM Pre-Environmental Review (PER) was delayed from September to October 2012 due to multiple integration and test issues. NASA allowed the extra time so the project could investigate High Gain Antenna System mechanical interference and GPM Microwave Imager (GMI) Radio Frequency interference. The delay also allowed the project to closeout several subsystem test Problem Reports and complete installation of the remaining Thermal Control System components. All of these activities were necessary prior to NASA conducting the Comprehensive Performance Test (CPT), which is required prior to conducting the PER.</p> <p>Throughout the GPM project, NASA has had to adjust the schedules as a result of challenges in component deliveries, delivery of the partner-provided instruments, and system integration and test, which are often encountered during the development of space flight hardware. However, subsequent to a replan, the project has maintained its budget and launch date commitments, despite additional delays to interim milestones.</p>	
<p>FY 2012 Performance Improvement Plan: NASA resolved GPM's integration and test issues. All required work was completed and the CPT was completed on October 16, 2012. NASA completed the GPM PER on October 22-23, 2012. No further performance improvement activities are necessary.</p>	

<p>Acquisition Management Challenges</p>	
<p>10SFS08</p>	
<p>Accountable Organization: Space Operations Mission Directorate, Space Communications and Navigation</p>	
<p>Complete SN Ground Segment Sustainment project (SGSS) Mission Definition Review.</p>	
<p>Why Measure 10SFS08 Was Not Met: The SGSS Mission Definition Review did not occur as planned due to an on-going contractor protest.</p>	
<p>FY 2010 Performance Improvement Plan: NASA will develop a new plan and schedule for completing the Mission Definition Review once the protest is adjudicated.</p>	
<p>FY 2011 Update: The SGSS contract award was upheld in FY 2011. After the contract was initiated, it was determined that dividing the Mission Definition Review into two parts, with the first part focused on the technical</p>	

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review and the second part focused on budget, was the appropriate approach. The technical review, which was very successful, was held in July 2011; the second review is scheduled to be held in December 2011.	
10PS05	
Accountable Organization: Science Mission Directorate, Planetary Science Division	
Develop missions in support of this Outcome, as demonstrated by selecting concept studies for the Discovery 12 mission.	
<i>Why Measure 10PS05 Was Not Met:</i> The acquisition timeline for the Discovery 12 mission was extended due to the complexity of the Announcement of Opportunity, which includes the potential use of radioisotope power systems.	FY 2010 Yellow
<i>FY 2010 Performance Improvement Plan:</i> Twenty-eight proposals have been received. Selection of concept studies is scheduled for mid-FY 2011.	
<i>FY 2011 Plan Update:</i> In May 2011, NASA selected three mission concepts (GEMS, TiME, and Comet Hopper) for study from the 28 proposals received. After a detailed review of the three concept studies in 2012, one will be selected as the 12th Discovery Program mission.	
AMO-11-12 (Performance Goal 5.2.2.1)	
Accountable Organization: Office of the Chief Information Officer	
Achieve Initial Operating Capability (IOC) for five Service Offices (Web Services, Communications, Enterprise Service Desk, End User Services, and NASA Enterprise Applications) as part of the NASA Information Technology Infrastructure Integration Program (I3P).	
<i>Why Measure AMO-11-12 Was Not Met:</i> Four of the five planned service offices achieved Initial Operating Capability (IOC). The End User Services (ACES), Enterprise Applications (EAST), Enterprise Service Desk (ESD), and Communications (NICS–Networking) services all have their office structures in place, are managing the transition to these new services, and continue to operate the current services. The one service office that did not reach IOC in FY 2011 is the one for the Web services (WEST). The implementation of this initiative has been delayed to resolve some issues with the contract award. NASA remains on track for the consolidation and centralization of these services and capabilities by 2014.	FY 2011 Yellow
<i>FY 2011 Performance Improvement Plan:</i> NASA will continue to work through the issues with the contract award of the web services capability. The implementation of the WEST will be revisited once these issues are resolved.	
<i>FY 2012 Update:</i> NASA resolved issues with the contract award for WEST. Under the resolution, the originally planned Web Services were restructured and NASA has released a solicitation for WESTPRIME. NASA currently is evaluating the proposals received from the solicitation.	
PS-12-2 (Performance Goal 2.3.1.2)	
Accountable Organization: Science Mission Directorate, Planetary Science Division	
Complete New Frontiers 3 Preliminary Design Review.	
<i>Why Measure PS-12-2 Was Not Met:</i> At the time of the performance plan update, NASA had not completed the final negotiation on the procurement the Origins Spectral Interpretation Resource Identification Security Regolith Explorer (OSIRIS-REx) mission. The final agreement resulted in a proposed extended Phase B for the OSIRIS-REx project, which moved the Preliminary Design Review (the APG milestone) beyond fiscal year 2012, with the planned completion of the Mission Definition Review in FY 2012 instead. NASA made this change to reduce risk	FY 2012 Yellow

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to cost and schedule performance for the project.	
<i>FY 2012 Performance Improvement Plan:</i> NASA has completed the Preliminary Design Review. No further performance improvement activities are necessary.	

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Highlighted Performance Trend: Commercial Spaceflight Successfully Reaching the International Space Station

In FY 2012, NASA’s Commercial Orbital Transportation Services partners, Space Exploration Technologies Corporation (SpaceX) and Orbital Sciences Corporation (Orbital), continued to make progress toward developing systems to provide cargo resupply services to the International Space Station (ISS). Leveraging commercial partners for these tasks is a new way of doing business for NASA, and the activity continues to be a learning experience for both NASA and the partners. As the partners transitioned from development to integration and testing, they encountered technical challenges, as is common in the development of any major space system. The resolution of these challenges has caused delays to the partners’ demonstration flights.

Outcome 5.2	
Accountable Organization: Exploration Systems Mission Directorate, Constellation Systems	
By 2010, demonstrate one or more commercial space capabilities for ISS cargo and/or crew transport.	FY 2010 Yellow
<i>Why Outcome 5.2 Was Not Met:</i> Both partners, Space Exploration Technologies Corporation (SpaceX) and Orbital Sciences Corporation (Orbital), are making progress in demonstrating their respective transportation capabilities. The partners moved their initial demonstration flights to FY 2011 due to technical issues encountered during development efforts.	
<i>FY 2010 Performance Improvement Plan:</i> SpaceX is planning for its first ISS demonstration flight in late fall 2010, with remaining flights scheduled for later in FY 2011. Orbital currently is planning its demonstration flight for fall 2011.	
<i>FY 2011 Update:</i> NASA Commercial Orbital Transportation Services (COTS) partner SpaceX successfully completed their Demonstration 1 mission on December 8, 2010.	
10CS07	
Accountable Organization: Exploration Systems Mission Directorate, Constellation Systems	
In FY 2010, have at least one partner demonstrate flight proximity operations with ISS.	FY 2010 Yellow
<i>Why Measure 10CS07 Was Not Met:</i> Both partners, SpaceX and Orbital, made progress in demonstrating their respective transportation capabilities. The partners moved their initial demonstration flights to FY 2011 due to technical issues encountered during development efforts and are continuing toward demonstrating flight operations with ISS in FY 2011.	
<i>FY 2010 Performance Improvement Plan:</i> The second SpaceX flight, in June 2011, will demonstrate flight proximity operations with ISS. Orbital currently anticipates scheduling its demonstration flight for FY 2012.	
<i>FY 2011 Update:</i> APG 10CS07 was not completed in FY 2011 due to development challenges. Partner experienced delays as their program transitioned from design to integration and test; however, they continue to make technical progress toward their development and demonstration milestones. These challenges continue to be resolved, and NASA continues to work with our partners.	

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10CS08	
Accountable Organization: Exploration Systems Mission Directorate, Constellation Systems	
By the end of FY 2010, conduct one or more demonstration flights to, and berth with, the ISS.	FY 2010 Yellow
<i>Why Measure 10CS08 Was Not Met:</i> Both partners, SpaceX and Orbital, made progress in demonstrating their respective transportation capabilities. The partners moved their initial demonstration flights to FY 2011 due to technical issues encountered during development efforts and are continuing toward demonstration flights to, and berthing with, ISS in FY 2011.	
<i>FY 2010 Performance Improvement Plan:</i> SpaceX is planning for its third demonstration flight to, and berth with, ISS in late FY 2011. Orbital currently anticipates scheduling its demonstration flight for FY 2012.	
<i>FY 2011 Update:</i> APG 10CS08 was not accomplished due to development challenges. Partner experienced delays as their program transitioned from design to integration and test, they both continue to make technical progress toward their development and demonstration milestones. These challenges continue to be resolved, and NASA continues to work with our partners.	

In FY 2011, NASA augmented funding for the COTS Space Act Agreements with additional milestones for risk-mitigation, including a first flight of Orbital's Taurus II launch vehicle. NASA worked with its partners to ensure success of the COTS development through completion of demonstration flights and start of commercial resupply services to ISS in FY 2012. In May 2012, SpaceX launched its first demonstration of its COTS capabilities and then successfully reached ISS with the first commercial resupply mission in October 2012. In Spring 2013, Orbital plans to demonstrate proximity operations and ISS berthing to complete the COTS milestones and prove maturity of the systems for ISS commercial resupply services.

NASA reviewed its annual performance goals (APGs) related to commercial spaceflight development from FY 2010 to FY 2012. The APGs below demonstrate the technical challenges inherent to development of major space systems. In FY 2010, the Agency rated Yellow one outcome and two annual performance goals; in FY 2011, NASA rated two APGs Yellow. NASA and its partners continue to address these challenges while progressing toward success. As of FY 2012, NASA rated Green its two APGs related to commercial spaceflight development. These APGs reflect the success of SpaceX's demonstration flights in 2012.

CS-11-2 (Performance Goal 1.2.1.1)	
Accountable Organization: Human Exploration and Operations, Commercial Spaceflight	
Conduct a minimum of one commercial cargo demonstration flight of proximity operations with ISS.	FY 2011 Yellow
<i>Why Measure CS-11-2 Was Not Met:</i> This annual performance goal was not met in FY 2011 and is planned to occur in FY 2012. This performance target was not accomplished due to development challenges by NASA's partners. These partners experienced delays as their programs transitioned from design to integration and test, and they both continue to make technical progress toward their development and demonstration milestones.	
<i>FY 2011 Performance Improvement Plan:</i> SpaceX and Orbital continue to make progress, mitigating risk and solving technical challenges, and plan a demonstration of proximity operations with ISS in FY 2012. During FY 2011, NASA negotiated additional risk mitigation milestones with each partner. The additional milestones help to improve mission success by (1) augmenting ground and flight testing; (2) accelerating development of enhanced cargo capabilities; or (3) further developing ground infrastructure needed for commercial cargo capabilities.	

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<p>FY 2012 Update: SpaceX successfully conducted proximity operations with ISS during its commercial cargo transportation system demonstration mission to ISS in May 2012. The SpaceX demonstration flight was originally planned as two flights during FY 2012, one that would demonstrate proximity operations and another that would safely berth with ISS; however, SpaceX requested, and the ISS Program approved, combining the two flights into one flight.</p>	
<p>CS-11-3 (Performance Goal 1.2.1.1)</p>	
<p>Accountable Organization: Human Exploration and Operations, Commercial Spaceflight</p>	
<p>Conduct a minimum of one safe berthing of commercial cargo transportation systems with the ISS.</p>	
<p>Why Measure CS-11-3 Was Not Met: This annual performance goal was not met in FY 2011 and is planned to occur in FY 2012. This performance target was not accomplished due to development challenges by NASA's partners. These partners experienced delays as their programs transitioned from design to integration and test, and they both continue to make technical progress toward their development and demonstration milestones.</p>	<p>FY 2011 Yellow</p>
<p>FY 2011 Performance Improvement Plan: SpaceX and Orbital continue to make progress and plan to conduct a minimum of one safe berthing of commercial cargo transportation systems with the ISS in FY 2012. During FY 2011, NASA negotiated additional risk mitigation milestones with each partner to help improve mission success.</p>	
<p>FY 2012 Update: SpaceX demonstrated a safe berthing with ISS in May 2012. Orbital is expected to do the same in early calendar year 2013.</p>	

<p>ISS-12-3 (Performance Goal 1.1.1.3)</p>	
<p>Accountable Organization: Human Exploration and Operations, International Space Station</p>	
<p>Complete at least two flights to the ISS by U.S. developed cargo delivery systems.</p>	
<p>SpaceX launched its first demonstration flight on May 19, 2012, berthed to ISS, and returned successfully on May 31. SpaceX conducted a second flight, providing cargo to ISS, in October 2012. The SpaceX demonstration flight was originally planned as two flights during FY 2012; however, SpaceX requested, and the ISS Program approved, combining the two into one flight. The SpaceX-1 cargo flight was planned for September 2012, but occurred in October due to a crowded on-orbit schedule. The first Orbital flight is planned for Spring 2013.</p>	<p>FY 2012 Green</p>
<p>CS-12-1 (Performance Goal 1.2.1.1)</p>	
<p>Accountable Organization: Human Exploration and Operations, Commercial Spaceflight</p>	
<p>Perform Commercial Orbital Transportation Services (COTS) cargo demonstration missions and continue commercial crew transportation systems development.</p>	
<p>On May 31, 2012, SpaceX successfully completed its final COTS demonstration mission to ISS, completing all test objectives. NASA continues to partner with multiple companies on commercial crew development activities and is nearing completion of the second phase of Commercial Crew Development agreements. For the next phase, NASA signed crew development Space Act Agreements in August 2012 for the Commercial Crew Integrated Capability initiative.</p>	<p>FY 2012 Green</p>

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Highlighted Performance Trend: Improved Performance Measurement Helps Identify Diversity Challenges

NASA values its workforce and strives to improve its productive environment. The ultimate goal is to ensure the workplace allows employees from diverse backgrounds, ethnicities, and genders to reach their potential and contribute to NASA’s mission. Multiple offices work together to this end, including the Office of Human Capital Management and the Office of Diversity and Equal Opportunity. NASA reviewed its APGs where performance fell short in the areas of workforce, workplace, and diversity. The APGs below demonstrate the results of NASA’s continuing efforts to improve the workforce environment for all employees through multiple initiatives.

The Office of Education also contributes to developing a diverse science, technology, engineering, and mathematics (STEM) workforce, one that NASA can draw upon to support future missions. Multiple factors can impact these efforts, including funding delays, imperfect data collection methods, and mid-year changes to priorities. In FY 2012, NASA modified its methodology for assessing progress toward the targeted participation of its higher education programs in the Office of Education, to improve insight and visibility into each program’s contribution. As planned, NASA also took the first step to include data from other mission organizations beyond NASA headquarters. Implementing the new methodology highlighted additional challenges across multiple programs that will require corrective actions to reach NASA’s targets. Specifically, past data collection mainly pointed to the Space Grant Program, the single greatest contributor; however, under the new methodology all programs’ impacts are being factored. To achieve greater participation at an Agency level for underserved and underrepresented populations and women, NASA plans to set a holistic strategy for greater contribution across the entire portfolio of projects.

The following tables list APGs from FY 2010 to FY 2012 that NASA rated Yellow: two in FY 2010, four in FY 2011, and one in FY 2012. Additionally, NASA rated one APG Red in FY 2012.

Continual Improvement of the Workforce Environment	
AMO-11-6 (Performance Goal 5.1.1.4)	
Accountable Organization: Mission Support Directorate, Office of Human Capital Management	
Identify and address at least two topics that employees identified in the latest Federal Employee Viewpoint Survey.	FY 2011 Yellow
<i>Why Measure AMO-11-6 Was Not Met:</i> Many of the planned activities were completed but several have been delayed into FY 2012. Specifically, the identified areas to be addressed, and their corresponding action plan, are as follows:	
<p>1) Continue focus on teamwork/working together to ensure mission success. Planned actions included continual monitoring of Shuttle workforce concerns through regular surveys; and instituting a team-building focus in Agency leader development programs. The activities toward this topic were completed in this fiscal year.</p> <p>2) Ensure that recognition and rewarding of employees is fair, consistent, and based on results-oriented performance. The planned actions included educating and training supervisors, through Agency supervisory</p>	

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<p>training courses; and implementing recommendations for enhancing the Agency’s Honor Awards Program. Both of these planned actions were delayed into FY 2012. This year’s funding level removed the option for conducting further Agency supervisory courses in FY 2011. Additionally, the development of new policies surrounding the Agency Honor Awards Program, is taking more time than planned, resulting in a delay until FY 2012.</p>	
<p>FY 2011 Performance Improvement Plan: These actions will be completed in fiscal year 2012. OHCM will continue focus on teamwork and working together to ensure mission success. Actions include continual monitoring of Shuttle workforce concerns through regular surveys; and team-building focus in Agency leader development programs. OHCM will also ensure that recognition and rewarding of employees is fair, consistent, and based on results-oriented performance. Actions include educating and training supervisors through Agency supervisory training course and to implement recommendations for enhancing the Agency’s Honor Awards Program.</p>	
<p>FY 2012 Update: In FY 2012, NASA continued to focus on teamwork to ensure mission success. OHCM worked with the Labor Union to improve the performance management process for General Schedule employees by developing process improvements to the current system, many of which were implemented in the current performance cycle (2012/2013). Informed by the results of a survey on leadership training needs for first line supervisors, OHCM addressed the role of a NASA supervisor, as well as placed an increased emphasis on assuring greater accountability for supervisors through the performance management process. OHCM implemented an improved, streamlined Agency Honor Awards process that provides more opportunities to award individuals for excellent work in a timelier manner.</p>	
<p>AMO-11-7 (Performance Goal 5.1.1.5)</p>	
<p>Accountable Organization: Office of Diversity and Equal Opportunity</p>	
<p>Complete FY 2011 actions described in the NASA Model Equal Employment Opportunity (EEO) Agency Plan.</p>	<p>FY 2011 Yellow</p>
<p>Why Measure AMO-11-7 Was Not Met: NASA made significant progress on many of 57 activities, contained in the Model EEO Agency Plan for FY 2011-2013, which have efforts in fiscal year 2011, but did not complete all the planned actions. NASA sought to complete 40 of the 57 actions in the first year of the Plan alone. NASA completed 14 of these actions (35 percent). In addition, NASA completed five actions not targeted for completion until FY 2012. Of the other actions targeted for completion in FY 2011, NASA has partially completed 19 (48 percent). NASA has completed key actions related to the Agency’s Anti-Harassment Program, Conflict Management Program, and the Functional Review Program is on track for completion of its actions. However, as a result of recent Executive Orders that required development of action plans in FY 2010-2011 for Asian Americans and Pacific Islanders, Individuals with Disabilities, and Veterans, NASA had to add multiple actions to the Model EEO Agency Plan. The initial development of these plans, dispositioning of community group comments, and introduction of approximately 20 new actions, mid-year, did not allow time for full progress to be made. All efforts continue to progress, and are expected for completion before the end of the plan’s timeframe.</p>	
<p>FY 2011 Performance Improvement Plan: NASA is committed to continuing the efforts to remove barriers to a diverse and inclusive workplace, conducive to employees reaching their potential. In order to fully meet the objectives of the Plan, in FY 2012, NASA will: 1) undertake a careful review of the remaining actions and their target dates, taking into account new information, such as recent Government-wide initiatives relating to EEO and diversity; and 2) revise the Plan accordingly.</p>	
<p>FY 2012 Update: NASA reviewed progress toward the planned FY 2011 actions and their target dates in the Model EEO Agency Plan. NASA also revised FY 2012 plans to assure that the outstanding actions were completed in the fiscal year. NASA made significant progress toward the completion of FY 2011 actions and expects to complete them by the end of FY 2013.</p>	

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An Inclusive and Diverse STEM Workforce	
10ED03	
Accountable Organization: Office of Education	
Serve 8,500 under-represented and under-served students in NASA higher education programs.	FY 2010 Yellow
<p>Why Measure 10ED03 Was Not Met: In FY 2009, 6,743 higher education students self-reported as being part of an underserved and underrepresented race or ethnicity. This represents 40.6 percent of the total number of higher education students served by NASA in FY 2009, an increase from 28 percent of all higher education students similarly reporting in FY 2008. Of all higher education students served by the Agency, 43 percent self-reported being women, an increase from 41 percent in FY 2008. These figures are well above national averages for participation of minority students according to the National Science Foundation’s report, Women, Minorities, and Persons with Disabilities in Science and Engineering, released in April 2010. The reduction in the number of minority higher education students served (6,743 students rather than the goal of 8,500) also reflects an increased emphasis on institutional awards for education and research, and a corresponding decrease in individual student awards. The overall reduction in direct support to all higher education students in turn affects the total number of higher education underserved and underrepresented students reached by NASA. In FY 2007, the total number of higher education students reached was 34,493; in FY 2008, the number dropped to 24,362, in FY 2009, it dropped further to 24,168. Higher education projects are adjusting to address this trend, but there is significant lag time before results are available (e.g., new course development time, time to execute activities, grant reporting lag time). Another factor adversely influencing the number of individual student awards is the increasing cost of education. To offer individual awards that remain competitive with those of other federal programs and industry, NASA grantees must increase award amounts that meet cost increases in tuition, travel, and other expenses. In a flat or reduced budget environment, an increase in award size means that fewer direct support awards can be made.</p>	
<p>FY 2010 Performance Improvement Plan: NASA higher education projects are actively working to increase the participation of underrepresented and underserved students. Future efforts include plans to work more closely with community colleges and institutions that tend to serve large numbers of underserved students. The Space Grant Program, which works with affiliates in all 50 states, the District of Columbia, and Puerto Rico, has actively encouraged state consortia to better engage minority-serving institutions in their networks. The consortia are accountable for improving the participation of underserved students in their programs, determined as a percentage of their audience base. The strategy has been successful, as participation of racially and ethnically underserved and underrepresented students in the Space Grant Program has increased from 15 percent in FY 2007, to 21 percent in FY 2008, and to 29 percent in FY 2009.</p>	
<p>FY 2011 Update: The performance improvement plan was successful, and NASA was able to work more closely with community colleges in FY 2010. In doing so, NASA increased its overall reach to underrepresented and underserved populations. However, the number of underrepresented and underserved students reported for FY 2010 does not reflect the increases seen in previous years, due to the availability of data associated with Space Grant activities. NASA released a supplemental competition, not in the first round of competitions, to the Space Grant Consortia to assist in strengthening linkages with Minority Serving Institutions, but this data will not be available until the end of the 2011 calendar year. The competition was released in late FY 2010 due to on-going continuing resolutions which delayed funds. As a result, the currently available FY 2010 results only reflect underrepresented and underserved participation resulting from the standard Space Grant awards. The additional Space Grant awards, are expected to yield additional underrepresented and underserved participants, but will not be available until the grant performance period has concluded and grant reporting is completed.</p>	

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ED-11-1 (Performance Goal 5.1.2.1)	
Accountable Organization: Office of Education	
Achieve 40 percent participation of underserved and underrepresented (in race and/or ethnicity) in NASA higher education projects.	FY 2011 Yellow
<i>Why Measure ED-11-1 Was Not Met:</i> This annual performance goal was not met. Out of the 15,947 participants in NASA higher education programs who self-reported their race and ethnicity, 35 percent, reported being a member of an underserved or underrepresented race or ethnic group. NASA's aggressive goal of 40 percent, exceeds the national averages for underserved and underrepresented participation in higher education, and was a challenge that the Agency chose to undertake. The participation in NASA's programs did meet or exceed the percentages of underrepresented minorities pursuing higher education studies in STEM fields nationwide (between 11 to 21 percent of these degrees, at the bachelor level, according to the National Science Foundation Report, <i>Women, Minorities and Persons with Disabilities in Science and Engineering</i> : 2011).	
<i>FY 2011 Performance Improvement Plan:</i> The cultivation of diversity is a core value for all NASA education efforts, and NASA will challenge itself to continually improve. The performance improvement plan, that addressed the last fiscal year's performance, was successful in that NASA was able to work more closely with community colleges in FY 2010, which reflected in increases seen in FY 2011 measures. In doing so, NASA increased its overall reach to underrepresented and underserved populations, moving from one year to the next. NASA has refocused several projects within the Agency's higher education portfolio during FY 2011 in pursuit of this goal, including the announcement of two new grant opportunities targeted at minority serving institutions and community colleges, which tend to have larger populations of underserved and underrepresented students. In FY 2012, NASA will seek to improve the percentage of underrepresented and underserved students, that participate in its higher education programs by placing increased emphasis on inclusion and participation by these populations in the projects that reach the largest numbers of undergraduate and graduate students, such as the Space Grant Project. Additionally, NASA plans to take a more holistic look, across the Agency, where activities in the mission organizations, may be encouraging participation, and factor in this data for a more complete picture.	
<i>FY 2012 Update:</i> In FY 2012, NASA placed an increased emphasis on inclusion and participation in the Space Grant Program, which funds approximately 80 percent of the participants in the Office of Education's higher education programs. Specifically, NASA released a solicitation, through the Space Grant Program, focused on serving undergraduate and K-12 educators who are traditionally underrepresented in STEM fields. Additionally, NASA modified its methodology for assessing progress toward the targeted participation, to improve insight into each higher education program's contribution. NASA also took the first step at inclusion of the data from the mission organizations, the results of which are outlined in the explanation for ED-12-1.	
ED-12-1 (Performance Goal 5.1.2.1)	
Accountable Organization: Office of Education	
Achieve 40 percent participation of underserved and underrepresented (in race and/or ethnicity) in NASA higher education projects.	FY 2012 Red
<i>Why Measure ED-12-1 Was Not Met:</i> Out of the 15,585 participants in NASA higher education programs who reported their race and ethnicity, 24 percent reported being a member of an underserved or underrepresented race or ethnic group. NASA removed from the calculation the participants who did not report race or ethnicity. In an effort to better understand the percentage of all participants who may be from underserved or underrepresented populations, NASA also calculated the percentage of self-reported out of the total participants. Under this latter methodology, the participation is reduced to 21 percent. NASA estimates the actual percentage of underserved and underrepresented participants to be between these two figures. Additionally, NASA took a more holistic look across the Agency, where activities in the mission organizations may be encouraging participation, and factored this data. This reduced the overall percentage by one percent.	

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<p>FY 2012 Performance Improvement Plan: Based on the insights the changes in methodology highlighted, NASA is creating individual targets for each of its higher education programs, both in the Office of Education and in the mission organizations. These targets will ensure strategic contributions from all of the higher education programs, to achieve greater participation Agency-wide. Additionally, in FY 2013, NASA will seek to improve the percentage of underserved and underrepresented groups that participate in its higher education programs by continuing the One Stop Shopping Initiative (OSSI) for NASA Internships, Fellowships, and Scholarships opportunities. OSSI is a NASA-wide system for the recruitment, application, selection, and career development of undergraduate and graduate student participants. The OSSI Broker-Facilitator Corps will enhance the recruitment of students from all higher education institution types, including Hispanic-Serving Institutions, Predominately Black Institutions, including Historically Black Colleges and Universities, and Tribal Colleges and Universities. All of the Agency's education, internship, fellowship, and scholarship programs and projects will be encouraged to utilize OSSI.</p> <p>NASA will continue to improve its data collection strategies by striving to collect raw data as the events occur, and then verify and validate it on a quarterly basis to move the community towards process improvement practices through the year.</p>	
ED-11-2 (Performance Goal 5.1.2.1)	
Accountable Organization: Office of Education	
Achieve 45 percent participation of women in NASA higher education projects.	
<p>Why Measure ED-11-2 Was Not Met: This annual performance goal was not met. Out of the 15,568 participants in NASA higher education programs who self-reported their gender, 39 percent, reported being female. Albeit a greater number of women currently pursue higher education studies in the United States, men pursue a higher proportion of the degrees in science and engineering fields. For example, compared with men, women earn degrees at medium to low levels in physical sciences and mathematics (between 30 to 44% of these degrees), and at low levels in computer science and engineering (between 18 to 27% of these degrees). Despite the statistics, NASA still chose to set an aggressive goal of 45 percent, and fell just short of the challenge.</p>	
<p>FY 2011 Performance Improvement Plan: In FY 2012, NASA will seek to improve the percentage of women that participate in its higher education programs by placing increased emphasis on inclusion and participation by these populations in the projects that reach the largest numbers of undergraduate and graduate students, such as the Space Grant Project. NASA currently conducts a significant number of K-12 and informal STEM education projects that specifically target participation by pre-college girls. By stimulating interest in STEM among young females in the Agency's education pipeline, NASA expects that many of these students will remain engaged and continue to participate in NASA programs upon entering college.</p> <p>Additionally, NASA plans to take a more holistic look, across the Agency, where activities in the mission organizations, may be encouraging participation, and factor in this data for a more complete picture.</p>	FY 2011 Yellow
<p>FY 2012 Update: In an effort to provide a more comprehensive view of education performance within the Agency, NASA took the first step at inclusion of education project data from the mission organizations and NASA Centers, the results of which are outlined in the explanation for ED-12-2. Also in FY 2012, the Space Grant Program prepared a solicitation focused on serving groups traditionally underrepresented in STEM fields in the undergraduate and K-12 educator communities. NASA will release this solicitation in FY 2013.</p>	
ED-12-2 (Performance Goal 5.1.2.1)	
Accountable Organization: Office of Education	
Achieve 45 percent participation of women in NASA higher education projects.	
<p>Why Measure ED-12-2 Was Not Met: Of the 17,454 participants in NASA higher education programs who reported their gender, 35 percent reported being female. NASA removed from the calculation the participants who did not report gender. In an effort to better understand the percentage of all participants who may be women,</p>	FY 2012 Yellow

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<p>NASA also calculated the percentage of self-reported women out of the total participants. Under this latter methodology, the participation is reduced to 21 percent. NASA estimates the actual percentage of woman participants to be between these two figures. Additionally, NASA took a more holistic look across the Agency, where activities in the mission organizations may be encouraging participation, and factored this data. This made no appreciable difference to the overall percentage.</p>	
<p>FY 2012 Performance Improvement Plan: Based on insights highlighted by the changes in methodology, NASA is creating individual targets for each of its higher education programs, both in the Office of Education and in the mission organizations. These targets will ensure strategic contributions from all of the higher education programs, to achieve greater participation Agency-wide.</p>	
<p>10ED04</p>	
<p>Accountable Organization: Office of Education</p>	
<p>Achieve 60% employment of student participants in FY 2009 NASA higher education programs by NASA, aerospace contractors, universities, and other educational institutions.</p>	<p>FY 2010 Yellow</p>
<p>Why Measure 10ED04 Was Not Met: In FY 2010, NASA’s education workforce development target was 60 percent of students from NASA’s higher education programs entering into NASA-related careers. Of the 1,343 students who self-reported employment data, 625 students (or 46.5 percent) reported working for NASA, aerospace contractors, universities, or other educational institutions. One project, Motivating Undergraduates in Science and Technology (MUST) was used as a prototype for more closely mapping an Office of Education project directly to the NASA Early Career Hiring Initiative. This collaborative approach succeeded in placing 22 of 29 graduates with NASA and JPL. The overall drop in employment rate in these specific sectors, relative to previous years, may be a result of uncertainty in NASA’s plans (e.g., retirement of Space Shuttle Program, future of the Constellation Program), and overall poor health of the U.S. economy in 2008/2009. However, 38.6 percent of graduates (in addition to those hired by NASA, aerospace industry and educational organizations) chose STEM-related careers. One might conclude that NASA in-depth education experiences are indicative of STEM workforce preparation.</p>	
<p>FY 2010 Performance Improvement Plan: NASA organizations with a stake in developing the future workforce will continue to work collaboratively with each other and industry partners to identify future workforce trends and needs. New efforts in the One Stop Shopping Initiative include closer collaboration between NASA’s hiring managers and mentors for higher education students.</p>	
<p>FY 2011 Update: The performance plan was successful. In the year following, of the graduates who participated in NASA Higher education programs and self-reported employment data, 60.3 percent reported working for NASA, aerospace contractors, universities, or other educational institutions. NASA organizations have worked collaboratively with each other, as well as industry partners, to meet their respective workforce needs. Additionally, closer collaboration between NASA’s hiring managers and mentors for higher education students have yielded positive results.</p>	

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Performance Improvement Plans for Unmet FY 2012 Measures, Non-trended

NASA reviewed its FY 2012 performance measures where performance fell short. These measures were not evaluated as part of a broader trend in performance. The following tables list performance measures that NASA rated Yellow or Red in 2012.

ERD-12-6 (Performance Goal 3.3.2.1)	
Accountable Organization: Human Exploration and Operations, Exploration Research and Development	
Complete tests of Extra Vehicular Activity (EVA) Portable Life Support System (PLSS) subsystem in a vacuum chamber environment.	FY 2012 Yellow
<i>Why Measure ERD-12-6 Was Not Met:</i> NASA rescheduled the test of the PLSS in a vacuum chamber to FY 2013 based on a realignment of funding to other priorities. Assembly of the device also was delayed due to component technology development timelines that were greater than anticipated.	
<i>FY 2012 Performance Improvement Plan:</i> NASA currently is assembling the second generation PLSS and preparing it for testing in FY 2013. NASA tested the first generation of the PLSS in FY 2011. The new technology components, which experienced a delay in FY 2012, have been completed and are being integrated into the system. NASA expects to assemble a third generation PLSS in 2014. This evolutionary approach allows for rapid and affordable development of prototype spacesuits, and design changes can be made in each generation to improve performance. The EVA project is still on track to demonstrate a new spacesuit on ISS by 2020.	
Performance Goal 5.2.2.4	
Accountable Organization: Mission Support Directorate	
By 2015, reduce data center energy consumption by 30 percent.	FY 2012 Yellow
<i>Why Performance Goal 5.2.2.4 Was Not Met:</i> NASA continued to meter all of the Agency's data centers to allow measurement of energy consumption and the subsequent effects of any improvements. NASA's models estimate that a reduction of approximately three percent has been realized to date, based on the closure of data centers. Congruent with data center closures, other activities were planned to contribute to energy savings: facility upgrades and improvement; replacement of old inefficient mechanical and IT equipment; and virtualizing underutilized IT infrastructure. Based on current plans, in the fiscally constrained environment, these latter activities will not be completed in a timeframe to achieve the targeted energy reduction.	
<i>FY 2012 Performance Improvement Plan:</i> In FY 2013, NASA plans to revisit this performance goal and to set targets more in line with its plans and other reporting. This performance goal is not consistent with the metrics being reported under the Federal Data Center Consolidation Initiative (FDCCI) and the NASA Strategic Sustainability Performance Plan. Additionally, NASA recognizes that improvements are needed to its predictive models and methodology, which will also be improved in the coming year.	

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ES-12-23(Performance Goal 2.1.5.3)	
Accountable Organization: Science Mission Directorate, Earth Science Division	
Reduce time within which 80 percent of NASA Research Announcement (NRA) grants are awarded, from proposal due date to selection, by four percent per year, with a goal of 180 days.	FY 2012 Red
<i>Why Measure ES-12-23 Was Not Met:</i> The Earth Science Division (ESD) completed 80 percent of FY 2012 selections within 236 days, a small improvement from FY 2011's 240 days. The magnitude of solicitations, based on coverage of the diversity of scientific disciplines, and the number of proposals received continues to provide a challenge to meeting the targeted reductions. Additionally, staff workload is a factor. The small improvement was the result of the development of an integrated plan for the year ahead outlining the solicitations, the expected proposal numbers, and scheduling of review panels, while taking staffing into consideration. However, the planning effort was only starting to take effect in the selections for the current review cycle.	
<i>FY 2012 Performance Improvement Plan:</i> The Earth Science Division will continue to implement its integrated plan in FY 2013 and will measure the impact at the end of the year.	
PS-12-17(Performance Goal 2.1.5.3)	
Accountable Organization: Science Mission Directorate, Planetary Science Division	
Reduce time within which 80 percent of NASA Research Announcement (NRA) grants are awarded, from proposal due date to selection, by four percent per year, with a goal of 180 days.	FY 2012 Red
<i>Why Measure PS-12-17 Was Not Met:</i> The Planetary Science Division completed 80 percent of their selections within 258 days, which represented a significant improvement from the FY 2011 performance of 290 days. The division did not achieve further improvement due to uncertainty in what level of funds would be available for award. The division delayed selections until the uncertainty was resolved.	
<i>FY 2012 Performance Improvement Plan:</i> The Planetary Science Division plans to adopt a strategy employed by the Astrophysics Division to improve the timeline for making selections, while still accounting for any funding uncertainties. Specifically, the division plans to provide partial funds early in the fiscal year for rapid selection of only the best proposals, ensuring that even if there are budget cuts, enough funds will remain for selections in programs scheduled later in the year. This partial funding in the fall will result in a low selection (acceptance) rate early in the year, but will speed overall selections. Later in the year, when the total budget is known, the division will make appropriate adjustments that may allow for more selections in these "early" programs.	

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Performance Results Inform Planning

The preceding assessment of NASA's performance shortfalls in FY 2012 and larger trends across the portfolio highlights the areas for continued monitoring in FY 2013 and beyond. As part of NASA's performance management cycle, the evaluation phase links to both the reporting and planning phases. Performance results are reported to Agency leadership and a wide range of stakeholders, including the White House, Congress, and the public. Equally important, performance results are a key factor in planning future activities. NASA takes advantage of the time between the end of the fiscal year and the release of the Congressional Justification to adjust performance plans for the current and next fiscal years.

Actions that NASA can take to improve performance include policy or procedural changes, increased oversight and assessments, and changes to a program's direction and plans. Based on the evaluation of FY 2012 performance, NASA:

- Made changes to the FY 2013 and FY 2014 plans, which are reflected in the enclosed versions;
- Reaffirmed that the cost and schedule estimation policy changes have been successful and have led to improved performance; and
- Planned more evaluation for on-going trends in areas like diversity and equal opportunity in STEM education activities.

NASA has already begun its performance management cycle for FY 2013 and will strive to improve performance at all levels of the Agency. NASA also will continue to plan, evaluate, and report in streamlined and more effective ways to provide the underpinning elements to drive this improvement.